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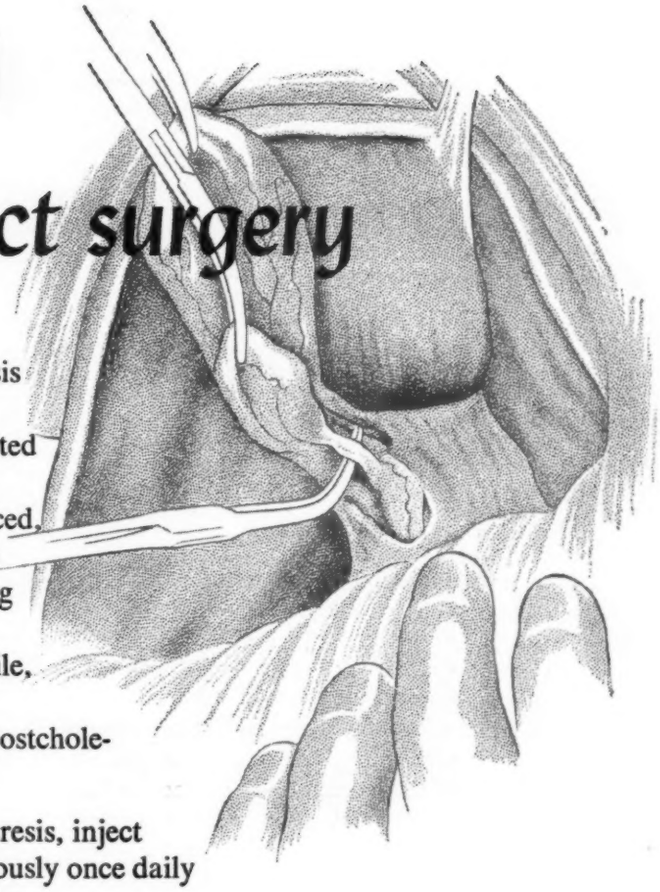

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References:

1. Bonica, J. J.: *Anesthesiology*, 11:716, Nov., 1950.
2. Moore, D. C.: *J. A. M. A.*, 146:803, June 30, 1951.
3. Bonica, J. J.: *Anesth. & Analg.*, 30:76, Mar.-Apr., 1951.

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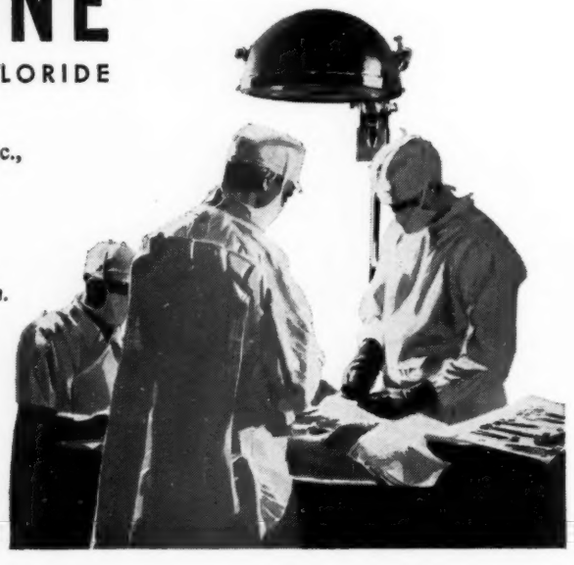

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The American Journal of Surgery

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Clinical Results* with Banthine® Bromide

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22 Published Reports Covering Treatment of 1443 Peptic Ulcer Patients with Banthine

Comprising the reports published in the literature to date which give specific facts and figures of the results of treatment

AUTHORS	No. of Patients	Chronic, Resistant to Other Therapy	TYPES OF ULCERS				RELIEF OF SYMPTOMS (Chiefly Pain)				Surgery or Complications[1]	Side Effects Requiring Discontinuance of Drug[2]	EVIDENCE OF HEALING			
			Duodenal	Jejunal	Stomal	Gastric	Good	Fair	Poor	No Report			Complete	Moderate	None	No Report
Grimson, Lyons, Reeves	100	100	93	7			80	11	4		5		47		19	29
Friedman	15	15	14			1	5		4	6[3]			2			13
Bechgaard, Nielsen, Bang, Gruelund, Tobiassen	26	26	21			5	16	4	6				8	6	12	
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Brown, Collins	117	99	117				97	7	8		5	8	55	9	8	40
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Rodriguez de la Vega, Reyes Diaz	5	4	5				4		1					3	2	
Winkelstein	116	116	102	8		6	102		14				53		18	45
Hall, Hornisher, Weeks	18	18	18				11		1	6[5]			18			
Maier, Meili	38	38	24			14[6]	27	7	4[7]				10	2	5	21
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Legerton, Texter, Ruffin	11		11				11									11
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Rossett, Knox, Stephenson	146		141			5	146					4[10]	53			93
TOTALS	*1443*	*968*	*1380*	*17*	*8*	*38*	*1142*	*132*	*131*	*12*	*26*	*54*	*552*	*52*	*179*	*634*
PERCENTAGES		67.8	95.6	1.2	0.6	2.6	81.3	9.4	9.3			3.7	70.5	6.6	22.9	

1. Not included in tabulations.
2. Included in "Relief of Symptoms" as "Poor" and in "Evidence of Healing" as "None."
3. Four had no symptoms when Banthine therapy was begun.
4. Of which seven were penetrative lesions and five partially obstructive.
5. No symptoms were present in four.
6. Two with symptoms only; no demonstrable ulcer.
7. Three were psychopathic patients and one had a ventricular ulcer of the lesser curvature.
8. Roentgen findings after treatment period of two weeks; forty-seven had duodenal deformity.
9. All returned to work within a week.
10. In these four, after relief of symptoms, Banthine was discontinued because of urinary retention.

During the past two years, more than 200 references to Banthine therapy in peptic ulcer and other parasympathotonic conditions have appeared in medical literature. Of these reports, 22 have presented specific facts and figures on the results of treatment in a total of 1,443 peptic ulcer patients, 67.8 per cent of whom were reported as chronic or resistant to other therapy. These results are tabulated above and show:

"Good" relief of symptoms was obtained in 81.3 per cent of the 1,405 patients on whom reports were available.

"Complete" evidence of healing was obtained in 70.5 per cent of the 883 patients on whom reports were available.

In all but 9.7 per cent, relief of pain was "good" or "fair." In all but 22.9 per cent, evidence of healing was "complete" or "moderate."

During treatment, 26 patients required surgery or developed complications other than ulcer which required discontinuance of the drug before results could be evaluated.

Of the remaining 1,417 patients, only 3.7 per cent experienced side effects sufficiently annoying to require discontinuance of the drug.

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*Volume containing complete references, with abstracts of 39 additional reports, will be furnished on request by

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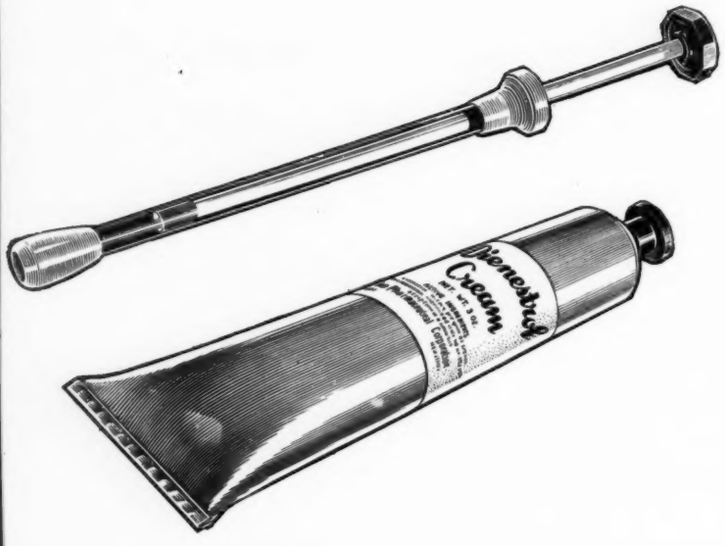

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1. Gordon, R. A., and Morton, M. V.: Anesthesiology **12**:680 (Nov.) 1951.

2. Smith, G.: GP **5**:61 (Apr.) 1952.

3. Pickrell, K. L.; Stephen, C. R.; Broadbent, T. R.; Masters, F. W., and Georgiade, N. G.: In Press.

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references:

1. Journal-Lancet 70:298, 1950.
2. Rocky Mountain M.J. 48:99, 1951.
3. Am. J. M. Sc. 218:298, 1949.
4. J. M. Soc. New Jersey 48:12, 1951.
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9. Southern M. J. 44:44, 1951.
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11. J. A. M. A. 146:250, 1951.
12. Circulation 1:508, 1950.

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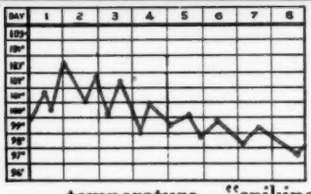
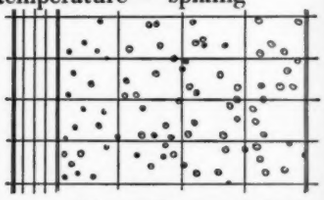
2 The onset is sudden, usually with a chill . . .



. . . temperature—"spiking"

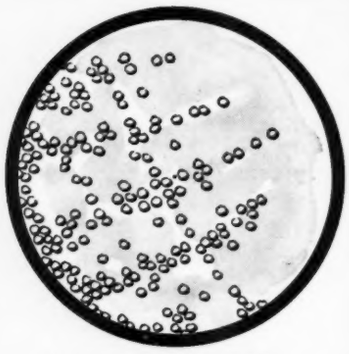


. . . white cell count—high

3 Always, pus cells and bacteria appear in the urine

look for *clumps* of white cells in *catheterized* specimens

4 Culture determines pathogen. Mixed infection not uncommon.



in 8 out of 10 children, colon bacillus invades

5 Sometimes there is tenderness over the kidney region . . .

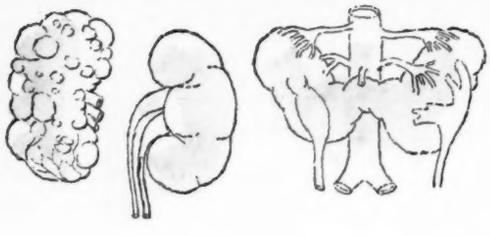
try the McKnight punch, or

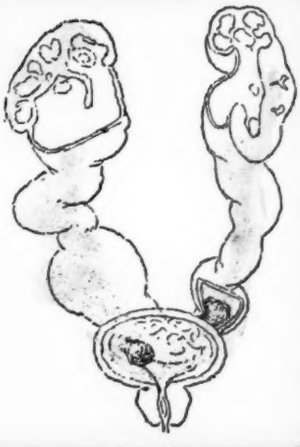
palpation in C-V angle

6 . . . or abdominal pain and rigidity

suggestive of an acute abdomen

7 Look for a cause of urinary stasis.





in children, 75% have congenital malformation . . . others may have calculus, foreign body, neoplasm, ureteral spasm.

INFECTIONS

CRYSTALLINE

Terramycin

Many urinary tract infections
as well as other infections
rapidly respond to therapy
with this well-tolerated
broad-spectrum antibiotic

Available in a wide variety of convenient dosage forms.

Pfizer *world's largest producer of antibiotics*

ANTIBIOTIC DIVISION, CHAS. PFIZER & CO., INC., BROOKLYN 6, N. Y.

more rapid relief of pain WITH THE **motorized intermittent tractolator***

WHEN CERVICAL TRACTION IS INDICATED

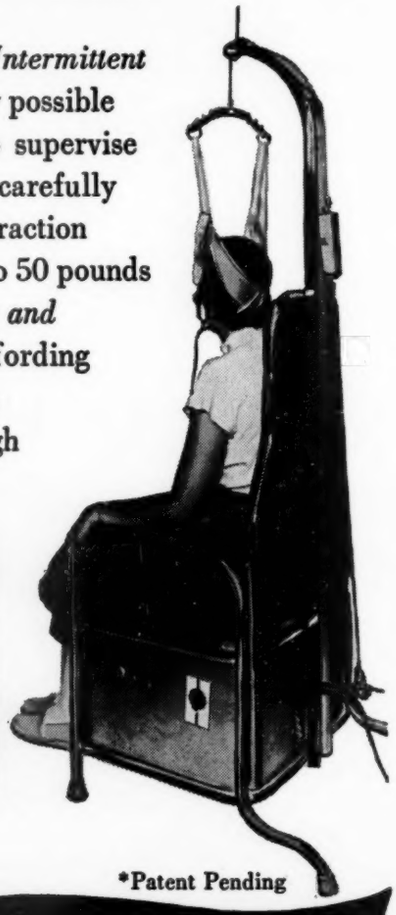
"Some patients who had previously received 5 to 8 pounds of constant traction without relief obtained rapid relief when 25 to 50 pounds of force were applied . . . Constant inadequate traction will not provide relief of pain; whereas adequate traction, even though applied intermittently, will often provide relief."

Intermittent Traction for Herniated Discs—by Bernard Judovich, M.D., Golda R. Nobel, M.D. Medical Times, Jan. 1952; Pain Syndromes—Bernard Judovich, William Bates. F. A. Davis Co., Philadelphia, 4th edition (in press) 1952.

Pain in the Shoulder, Neck, and Arm; Brachial Plexus pain due to:

- **Herniated Cervical Disc**
- **Osteoarthritis of the Cervical Spine**
- **Narrowed Intervertebral Foramen**
- **Other Conditions in Which Cervical Traction is Indicated**

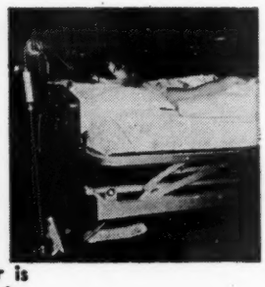
With the *Motorized Intermittent Tractolator*, it is now possible for the physician to supervise administration of a carefully graduated, smooth traction force with pulls up to 50 pounds *. . . safely, precisely and automatically* . . . affording relief of pain often unobtainable through other techniques.



Suitable for Hospital or Office Therapy

- *Comfortable*
- *Sturdy*
- *Automatic*

The *Motorized Intermittent Tractolator* is now in daily use in physicians' offices and hospitals. It is a dignified, handsome addition to your professional equipment, designed in consultation with the medical profession. Duration and amount of pull are automatic, once set for treatment. The apparatus is easily adjusted to the individual patient. Complete, simple instructions are provided with each Tractolator.



The *Motorized Intermittent Tractolator* is also available as a bed apparatus for cervical and lumbar traction. Details on request.

*Patent Pending

WRITE FOR INFORMATION, CASE HISTORIES, LITERATURE

Louis Yellin, Inc.
Surgical & Orthopaedic Appliances
251 South 17th Street
(Medical Tower Building)
Philadelphia 34, Pa.

Efocaine is an original development.† It is a solution of procaine and butyl aminobenzoate in a stable, water-miscible, non-oily vehicle. Injected pre- or postoperatively, contact with tissue fluids causes immediate deposition of the anesthetic agents to form a crystalline depot. This is absorbed slowly providing continuous sensory nerve anesthesia at the operative site for from 6 to 12 days or longer.

Clinically proved on hundreds of patients, Efocaine is free from the hazards of encapsulation, abscesses, foreign body reactions, tissue slough or other adverse effects of oil solutions.

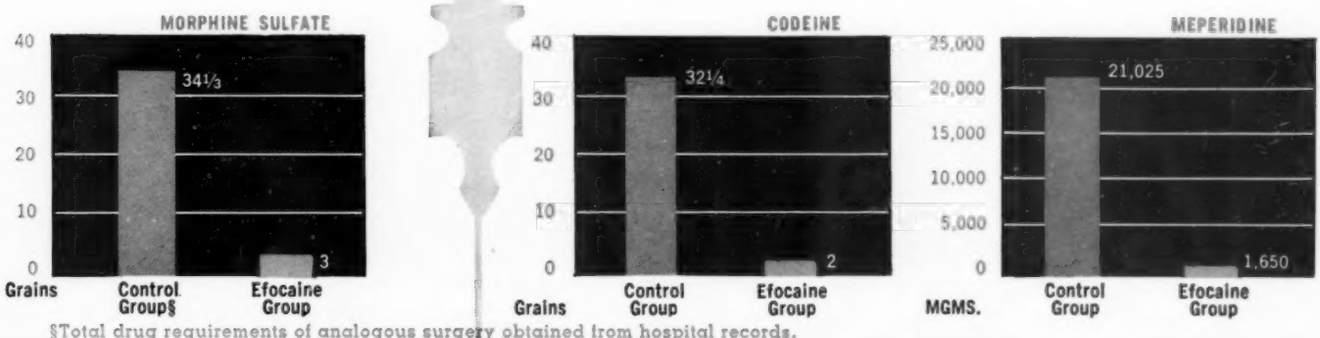
6-12 *days postoperative pain control from a single injection*

IN ANO-RECTAL, CHEST, ABDOMINAL AND MINOR SURGERY

Efocaine*

A DEPOT SOLUTION FOR PROLONGED LOCAL ANESTHESIA

Comparison of Postoperative Narcotic Needs
Efocaine Group and Control Group



§Total drug requirements of analogous surgery obtained from hospital records.

Postoperative Narcotics Virtually Eliminated

A comparison of 87 Efocaine-treated patients (14 different surgical procedures) with an equal number of untreated patients showed that Efocaine effects a remarkable reduction in postoperative narcotic needs.‡

Efocaine Fougera

safe • non-oily • aqueous-miscible • contains no vasoconstrictors

Supplied in 20-cc. multiple-dose vials through your usual source of supply.

LITERATURE ON REQUEST

‡Iason, A. H., and Shaftel, H. E.: A New Approach to the Problem of Postoperative Pain, Am. J. Surg. 83, (April) 1952.

FOUGERA

E. FOUGERA & COMPANY, INC • 75 VARICK STREET, NEW YORK 13, N. Y.

*T. M. †Patent applied for

when other external therapy seems to get **nowhere...**

accelerate healing with

Study[1], after study[2] after study[3] corroborates the "notable"[1] success of Desitin Ointment in easing pain and stimulating smooth tissue repair in lacerated, denuded, chafed, irritated, ulcerated tissues—often in stubborn conditions where other therapy fails.

Protective, soothing, healing, Desitin Ointment is a non-irritating, blend of high grade, crude Norwegian cod liver oil (with its unsaturated fatty acids and high potency vitamins A and D in proper ratio for maximum efficacy), zinc oxide, talcum, petrolatum, and lanolin. Does not liquefy at body temperature and is not decomposed or washed away by secretions, exudate, urine or excrements. Dressings easily applied and painlessly removed. Tubes of 1 oz., 2 oz., 4 oz., and 1 lb. jars.

write for **samples** and literature

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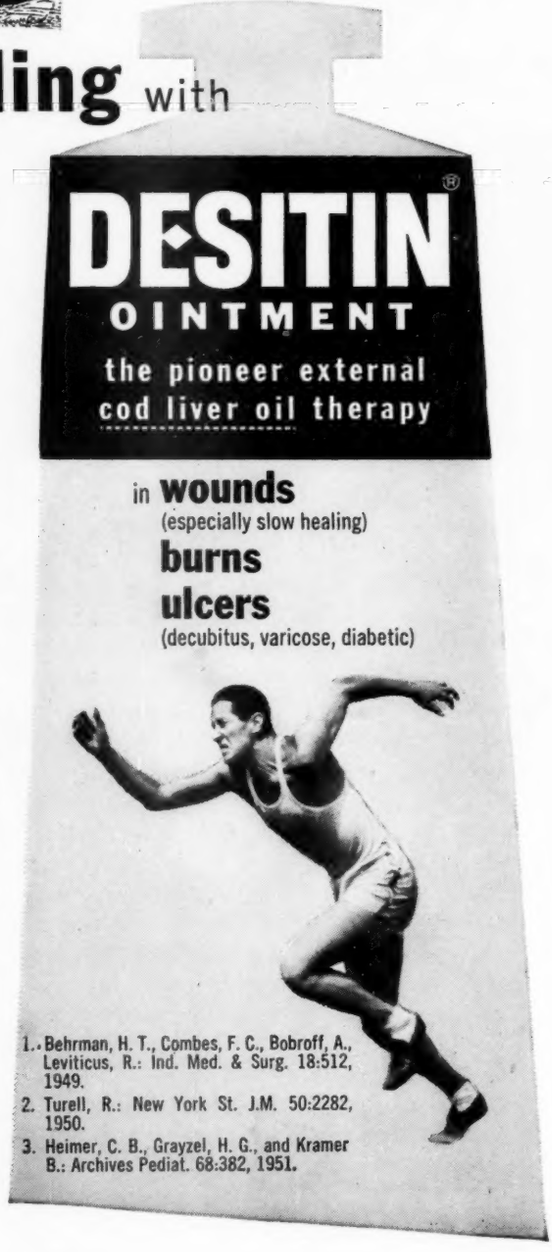
70 Ship Street, Providence 2, R. I.


DESITIN®
OINTMENT
the pioneer external cod liver oil therapy
in wounds
(especially slow healing)
burns
ulcers
(decubitus, varicose, diabetic)
1. Behrman, H. T., Combes, F. C., Bobroff, A., Leviticus, R.: Ind. Med. & Surg. 18:512, 1949.
2. Turell, R.: New York St. J.M. 50:2282, 1950.
3. Heimer, C. B., Grayzel, H. G., and Kramer B.: Archives Pediat. 68:382, 1951.

VARIATIONS IN DIAMETER
DECREASE TENSILE STRENGTH

ETHICON®
TRU-GAUGED
Surgical Gut

Ethicon's exclusive Tru-Gauging process provides remarkable uniformity of gauge and strength. *All* Ethicon Surgical Gut testing standards are far above U.S.P. minimum tensile strength requirements, permitting the use of smaller strands without sacrifice of suture strength.

ETHICON SUTURE LABORATORIES INCORPORATED
SUTURE LABORATORIES AT NEW BRUNSWICK, N. J.; CHICAGO, ILL.; SAO PAULO, BRAZIL; SYDNEY, AUSTRALIA; EDINBURGH, SCOTLAND.

COMPLETE ABSORPTION AT THE PROPER TIME

ETHICON *Surgical Gut*

Tru-Chromicized

minimizes foreign body irritation after the wound is healed

Ethicon Tru-Chromicized Surgical Gut provides a safe margin of suture-holding strength during wound healing—but digests soon after the suture is no longer needed.

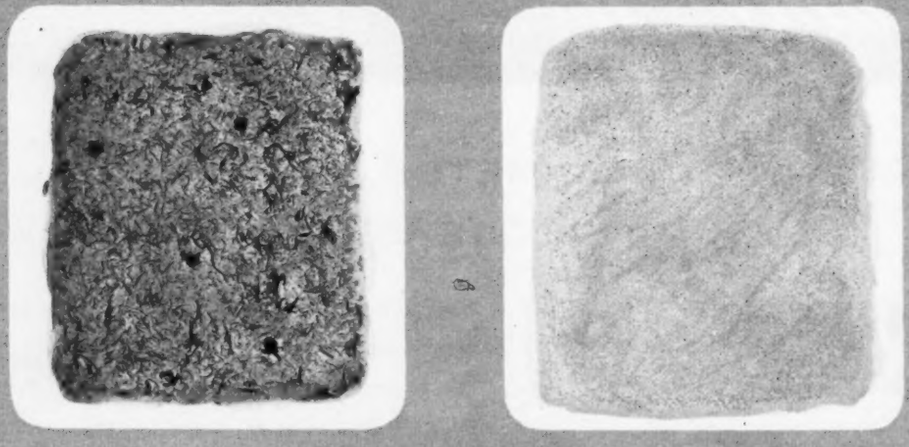
How Tru-Chromicizing Provides Safety and Reduces Irritation—In Ethicon's exclusive Tru-Chromicizing process, the individual ribbons of raw gut are chromicized *before* they are spun and dried. The chrome is evenly distributed and each portion of the strand, throughout the cross-section, has the same chrome content and enzyme resistance.

This more uniform chrome distribution not only assures maintenance of tensile strength throughout the normal healing cycle, but also provides an adequate safety margin for delayed healing. When the need for support has passed, *complete* digestion of the suture takes place.

Tru-Chromicizing permits the use of smaller sutures because Ethicon small sizes retain their holding power almost as long as larger sizes.

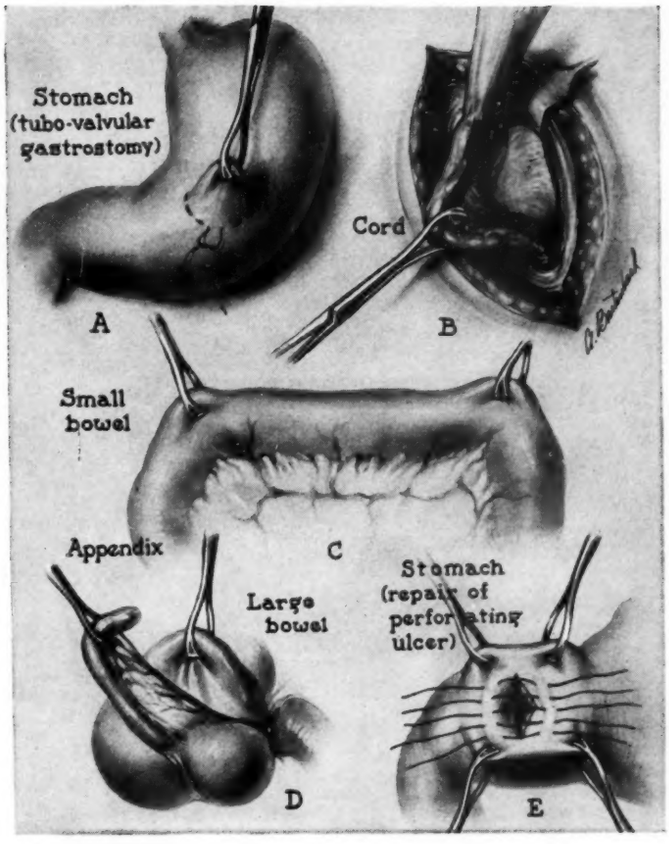
YOU COULD MAKE THIS SIMPLE TEST

Loops of gut were tied around a glass tube and immersed in 1% trypsin solution. After 200 hours (comparable to 6 months in tissue) the residue was spread on glass plates. Note the difference.



1. Ordinary surface chromicizing shows residue of undigested knots and suture fragments.

2. Tru-Chromicizing permits complete absorption, no undigested residue.



McNEALY-GLASSMAN NON-TRAUMATIZING VISCERA-HOLDING FORCEPS

A forceps of unusual flexibility, this improved instrument is sufficiently strong and secure in its application to prevent the tissues held in its grasp from being easily dislodged. However, even when applied to very delicate structures, the forceps has little tendency to crush or tear; four ratchets in its locking device allow a wide choice in the amount of force the surgeon can apply. The approximating jaws are about 1 cm. wide, have no sharp corners. Curved shanks permit encirclement of certain structures without crushing or constriction. The forceps is 6 inches long, nicely made, with box lock. Stainless. Each, $9.75

Laufman DISSECTING HEMOSTATS

Serving efficiently as both aneurysm needle and clamp, the Laufman Forceps facilitates the delicate dissections necessary in thyroidectomy, cholecystectomy, saphenous vein ligations and other situations, also gives the surgeon the added security of ligating behind a clamp while getting around the structure with the same single instrument. Dissecting and clamping may be done with one motion. Ligation in deep places is similarly facilitated as the suture cannot slip off the projecting tip of the forceps. For convenient attack of structures from either side, the forceps are made right and left. They are stainless steel. Each forceps (specify right or left) $17.50

INSTRUMENT MAKERS TO THE PROFESSION SINCE 1895

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B-P RIB-BACK
is more than a name

It is the hallmark of a fine surgical blade by any standard, reflecting infinite capacity for attention to every detail of quality production.

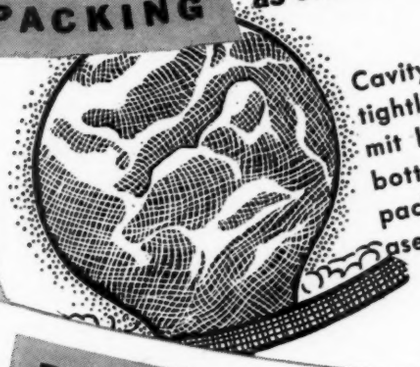
This means . . . uniform sharpness resulting in maximum cutting performance for the surgeon . . . reduction of time-consuming delays for the entire surgical team . . . an investment in economy for the budget-wise P.A.

B-P blades are now wrapped without oil in a chemical, rust-inhibiting package. No wiping is necessary before sterilization. Unused blades in an opened package may be rewrapped—still protected against corrosion.

Ask your dealer

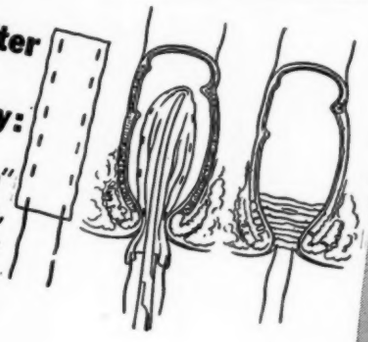
BARD-PARKER COMPANY, INC.
Danbury, Connecticut

PACKING as for abscess cavity:



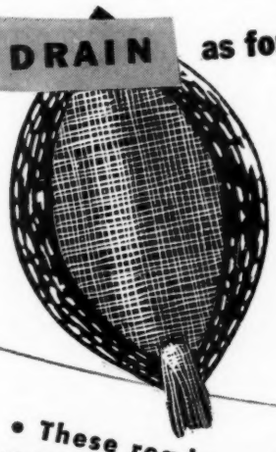
Cavity is fully but not tightly packed to permit healing from the bottom — and is repacked weekly, using aseptic precautions.

PLUG as after **hemorrhoidectomy:**



Petrolatum gauze "sponge" is (a) threaded as shown, (b) inserted beyond sphincter, (c) and then pulled down snugly against bleeding points.

DRAIN as for septic wounds:



Non-toxic, non-adherent, non-macerating—will not cause pressure necrosis or erosion...increasingly used in place of rubber drainage tubes.

• **These ready-made dressings now available in three sizes:**

No. 1: 3" x 36" (6 in carton)
No. 2: 3" x 18" (12 in carton)
No. 3: 6" x 36" (6 in carton)

Obtainable from your regular source of supply

Specified for "1001" SURGICAL USES

Vaseline

TRADE-MARK ®

Sterile Petrolatum Gauze Dressings

Adopted as standard procedure by surgeons, as preferred matériel by ORS's and CSS's, these superior dressings are used as wound coverings and packings, as plugs and drains—as well as being the most widely-used definitive dressing for burns and abrasions.

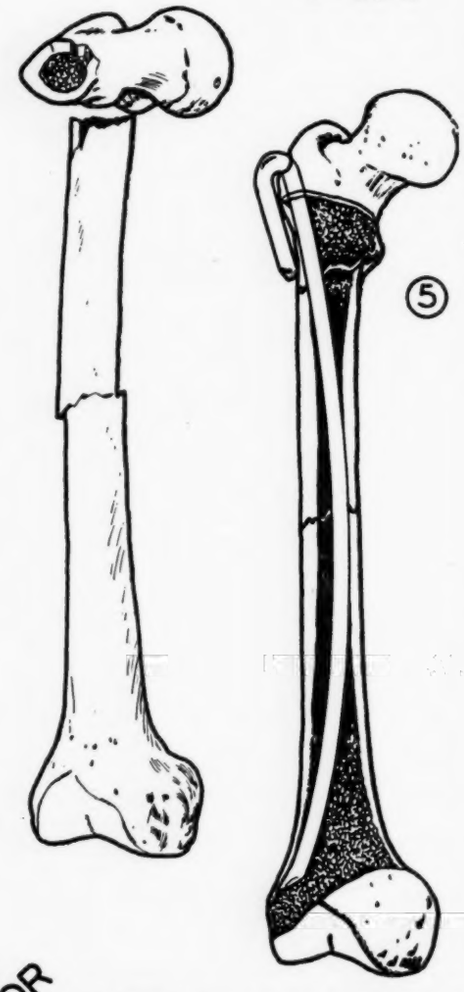
CHESEBROUGH MFG. CO., Cons'd
Professional Products Division
NEW YORK 4, N. Y.

Insist on these superior ready-made, dependably sterile dressings—for your use in indicated surgery, major or minor, emergency or elective.

VASELINE is the registered trade-mark of the Chesebrough Mfg. Co., Cons'd

The RUSH MEDULLARY PIN

SPECIAL FEMUR PIN



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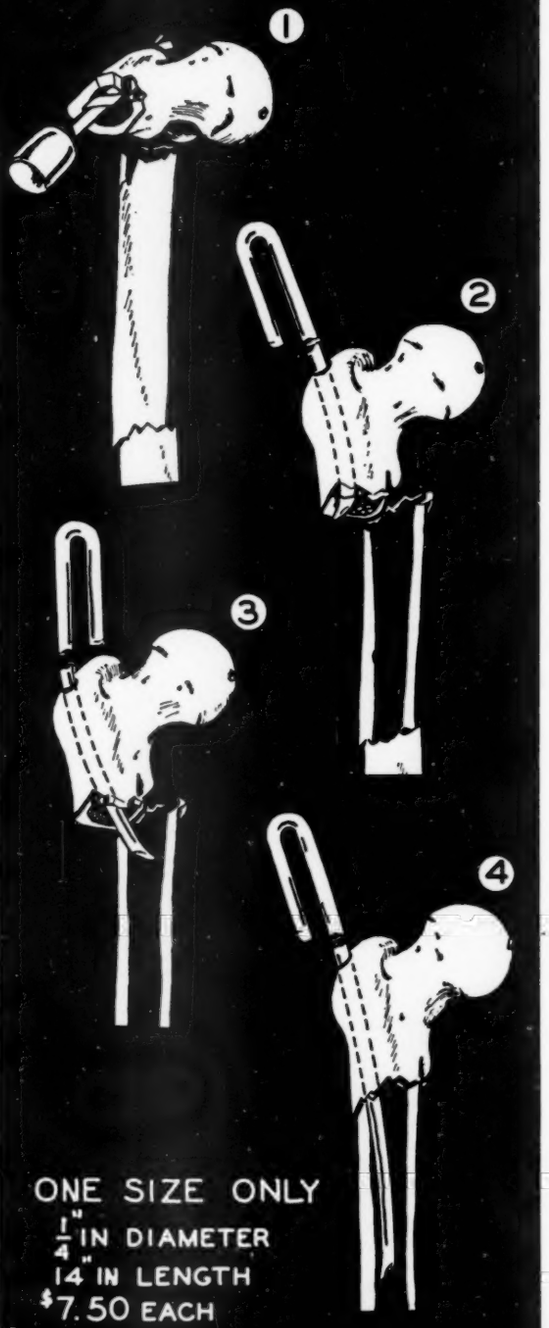

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1/4" IN DIAMETER
14" IN LENGTH
$7.50 EACH

FOR IMMEDIATE DELIVERY
WIRE OR PHONE: DAY-7195
NIGHT-2-2115

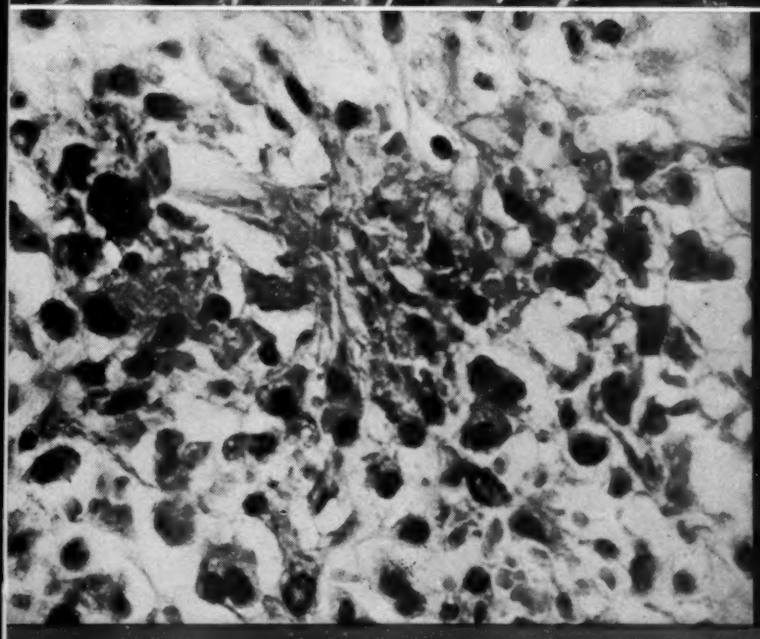
Manufactured Exclusively By . . .

THE BERIVON Company
Box 1851
MERIDIAN, MISSISSIPPI

response in rheumatic fever

q. Does cortisone influence the heart lesions of rheumatic fever?

a. Early cortisone administration suppresses and in some cases may even prevent serious cardiac damage.



q. What effect does cortisone have on acute rheumatic fever?

a. Often within 24 hours after cortisone therapy, the severely ill, toxic patient appears alert and comfortable; and within one to four days, temperature drops to normal, appetite increases, and polyarthritis subsides.

Cortisone Upjohn

available as Compressed Tablets Cortisone Acetate, 25 mg., for oral use. Bottles of 20 tablets.

THE UPJOHN COMPANY, KALAMAZOO, MICHIGAN

Meat...

and the Prevention of Tissue Wastage in the Aged

Accumulating evidence indicates that insufficient dietary protein is an important factor in the pathogenesis of the tissue wastage frequently encountered in the aged. On the other hand, a sufficient intake of biologically adequate protein, such as provided by meat, is a potent factor in the prevention of this phenomenon.

Wastage of body tissues appears to be one of the most characteristic and obvious changes in the geriatric patient.[1] However, such tissue wastage in elderly persons is not entirely the result of a primary metabolic change or an accompaniment of old age. Clinical studies indicate that protracted negative nitrogen balance, stemming from the habitual consumption of inadequate amounts of protein, plays an important contributory role.

Recent studies of dietary practices among persons from 40 to 75 years of age suggest that protein deficiency is a most likely and a highly significant deficiency found in elderly people.[2,3] In a study concerned with nitrogen balance in healthy elderly men,[4] it was shown that diets containing 0.5 Gm. of protein per kilogram of body weight were incapable of maintaining the subjects in nitrogen balance. Increase of the protein to 0.7 Gm. established equilibrium. Since young adults usually maintain nitrogen equilibrium on a protein intake of 0.5 Gm. of protein per kilogram of body weight, this study indicated that aging adults may require at least as high or a higher protein intake for maintenance of nitrogen equilibrium.[1]

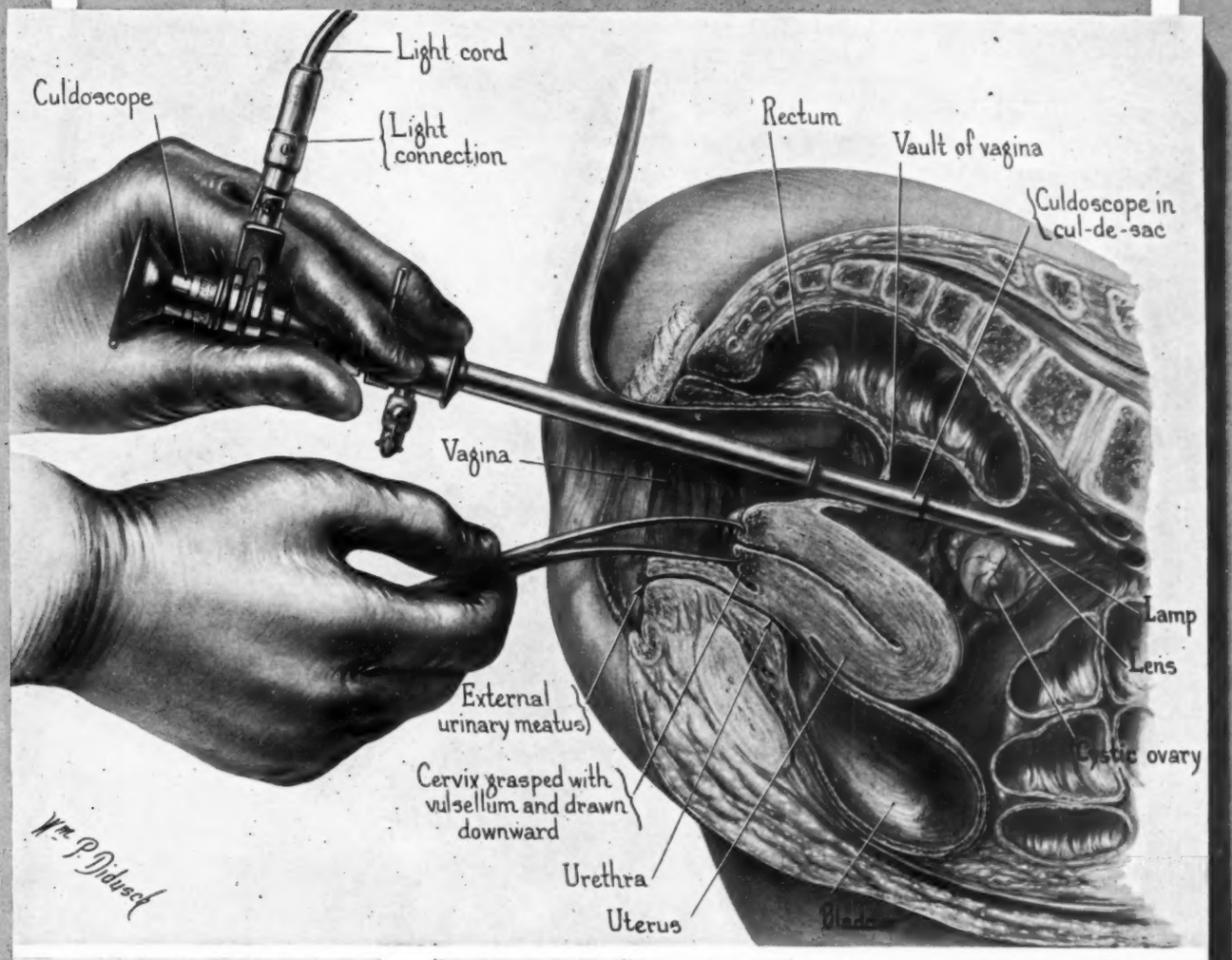
Meat merits a prominent place in the properly planned diet for the aged. Its rich store of biologically complete protein can play an important part in assuring nitrogen balance. In addition to protein, meat is also an excellent source of the B group of vitamins and of iron and other essential minerals. By physiologically stimulating the appetite and gastric secretion, meat promotes improved food intake and digestion.

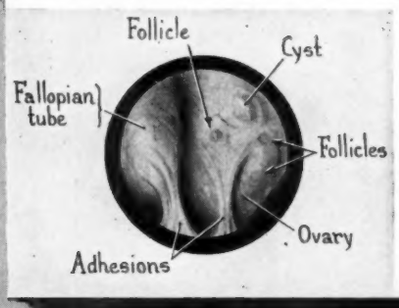
1. Kirk, J. E.: Nutrition and Aging, Nutrition Rev. *9*:321 (Nov.) 1951.
2. Ohlson, M. A.; Roberts, P. H.; Joseph, S. A., and Nelson, P. M.: Dietary Practices of One Hundred Women from Forty to Seventy-Five Years of Age, J. Am. Dietet. A. *24*:286 (Apr.) 1948.
3. Kountz, W. B.; Hofstatter, L., and Ackermann, P.: Nitrogen Balance Studies in Elderly People, Geriatrics *2*:173 (May-June) 1947; Nitrogen Balance Studies Under Prolonged High Nitrogen Intake Levels in Elderly Individuals, ibid. *3*:171 (May-June) 1948.
4. Kountz, W. B.; Hofstatter, L., and Ackermann, P.: Nitrogen Balance Studies in Four Elderly Men, J. Gerontol. *6*:20 (Jan.) 1951.

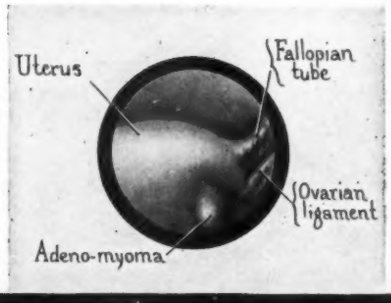
The Seal of Acceptance denotes that the nutritional statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

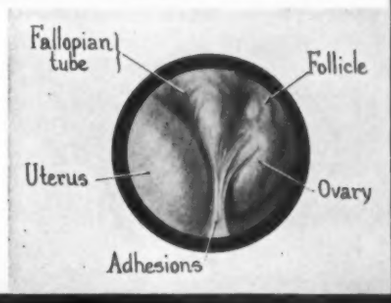
American Meat Institute
Main Office, Chicago...Members Throughout the United States

The Decker
CULDOSCOPE









The illustration above shows the Decker Culdoscope in endoscopic visualization of the female pelvic structures by the vaginal route. It permits direct study of pelvic tumors, ovarian pathologies, ectopic pregnancy, endometriosis, pelvic and intestinal adhesions, etc.

ESTABLISHED IN 1900 BY REINHOLD WAPPLER

FREDERICK J. WALLACE, *President*

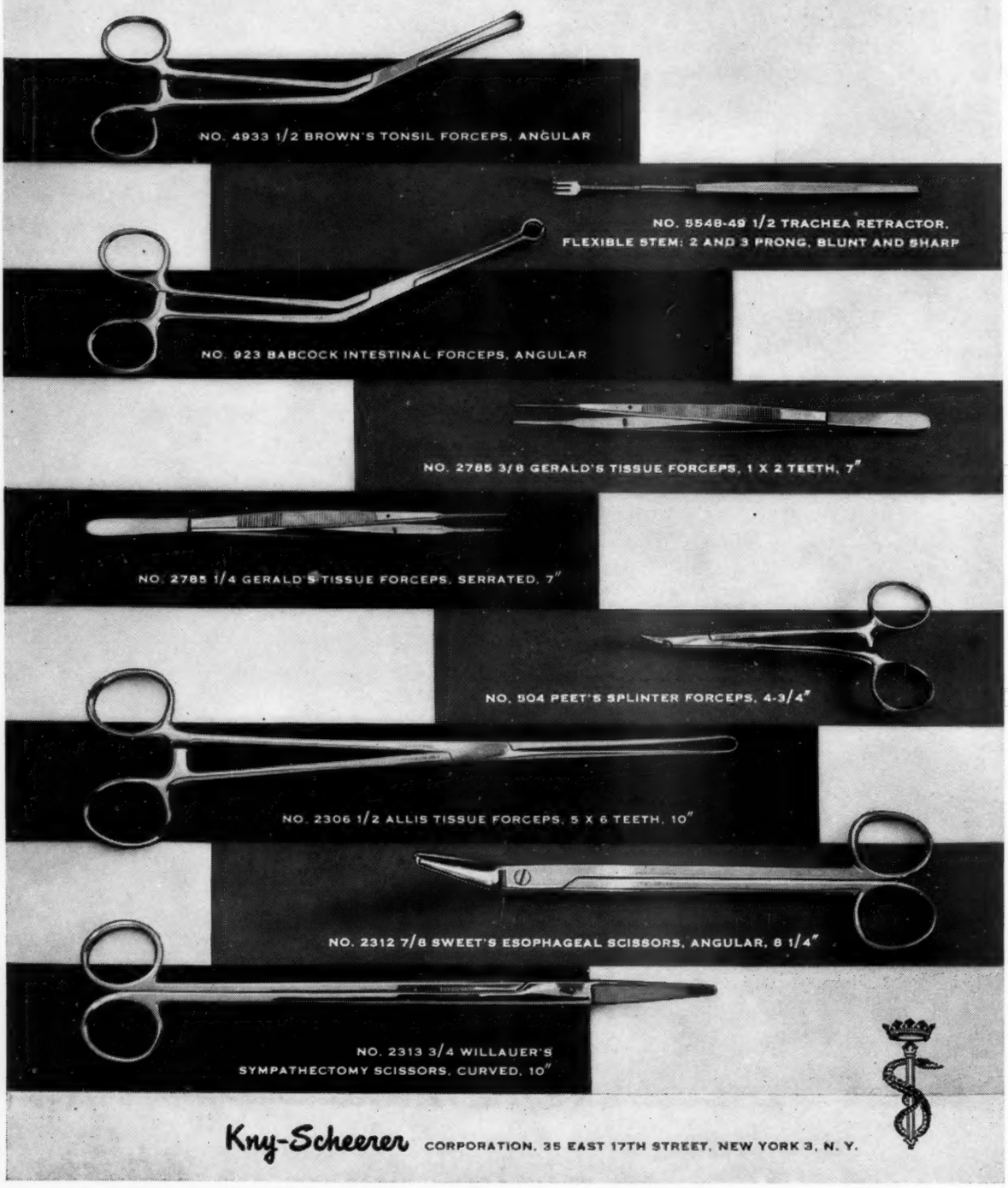
American Cystoscope Makers, Inc.

1241 LAFAYETTE AVENUE NEW YORK 59, N. Y.

The precision of a **Kny-Scheerer instrument**

complements the precision of the skillful surgeon.

Available exclusively through surgical dealers.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NO. 5548-49 1/2 TRACHEA RETRACTOR, FLEXIBLE STEM; 2 AND 3 PRONG, BLUNT AND SHARP
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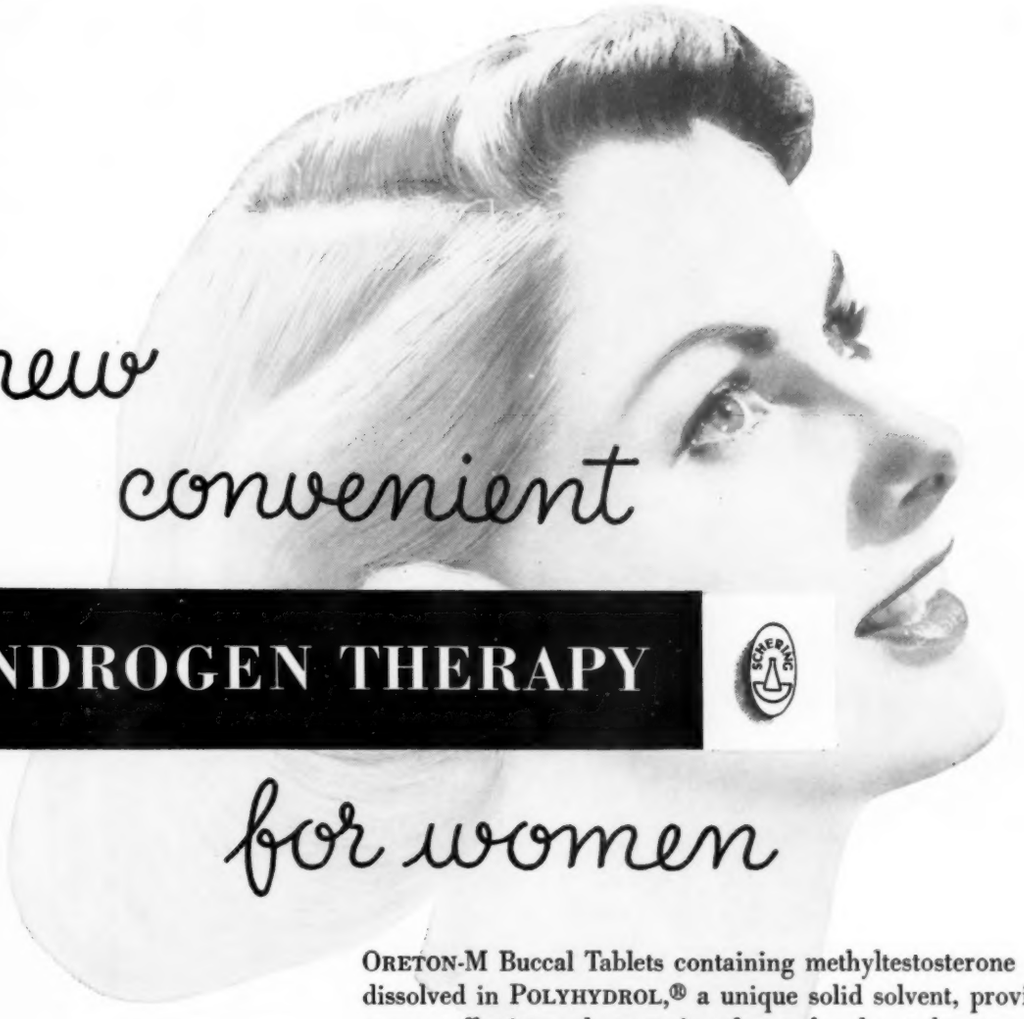
NO. 904 PEET'S SPLINTER FORCEPS, 4-3/4"
NO. 2306 1/2 ALLIS TISSUE FORCEPS, 5 X 6 TEETH, 10"
NO. 2312 7/8 SWEET'S ESOPHAGEAL SCISSORS, ANGULAR, 8 1/4"
NO. 2313 3/4 WILLAUER'S SYMPATHECTOMY SCISSORS, CURVED, 10"

Kny-Scheerer CORPORATION, 35 EAST 17TH STREET, NEW YORK 3, N. Y.



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convenient

ANDROGEN THERAPY

for women

ORETON-M Buccal Tablets containing methyltestosterone dissolved in POLYHYDROL,® a unique solid solvent, provide a more effective and convenient form of male sex hormone. The buccal route permits methyltestosterone to reach the circulation directly. Indicated for definitive relief of menopausal symptoms in special circumstances; for preventing pain of functional dysmenorrhea; and to relieve discomfort of breast engorgement.

Freedom from masculinizing side effects can be expected with recommended dosage of one-half to one and one-half 10 mg. ORETON-M® (Methyltestosterone U.S.P.) Buccal Tablets daily (5-15 mg.).

ORETON-M

buccal tablets

Schering CORPORATION • BLOOMFIELD, NEW JERSEY

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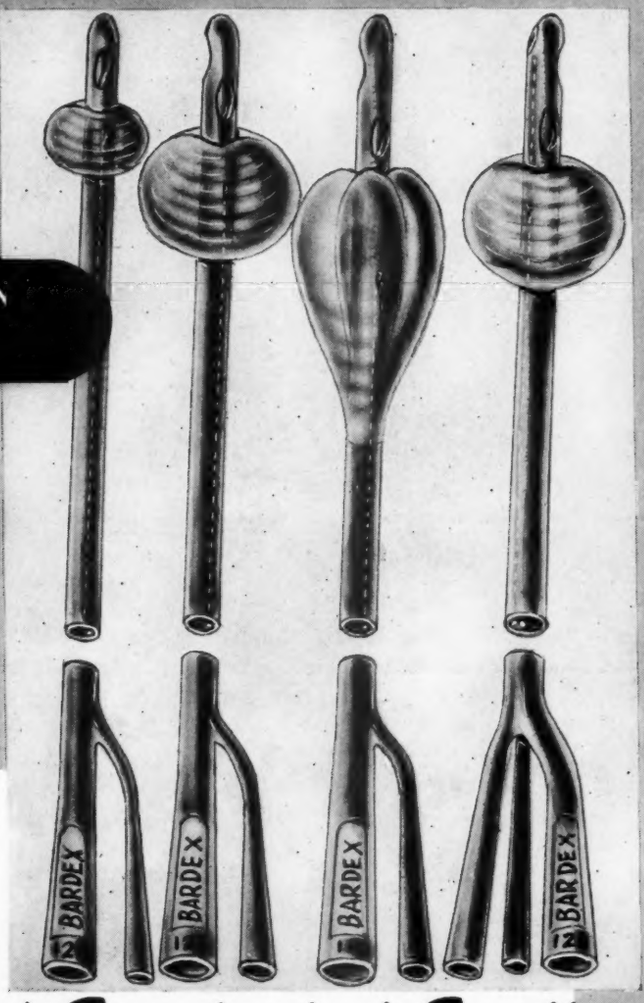

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1. Shute, W., and Shute, E.: Peripheral Thrombosis Treated with Alpha Tocopherol. Am. J. Surg. 84: August, 1952.

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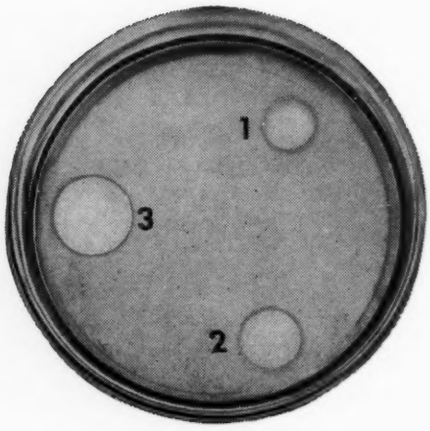

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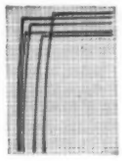

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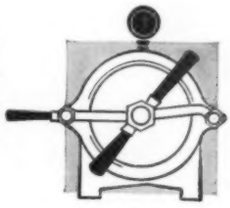

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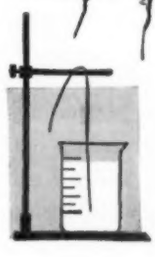

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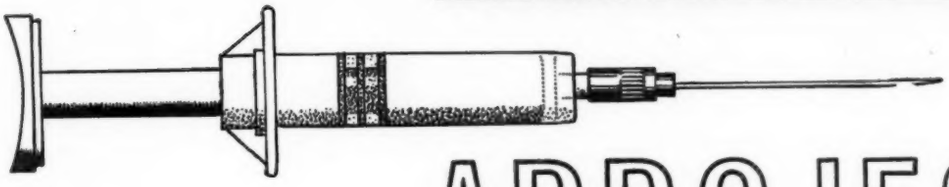

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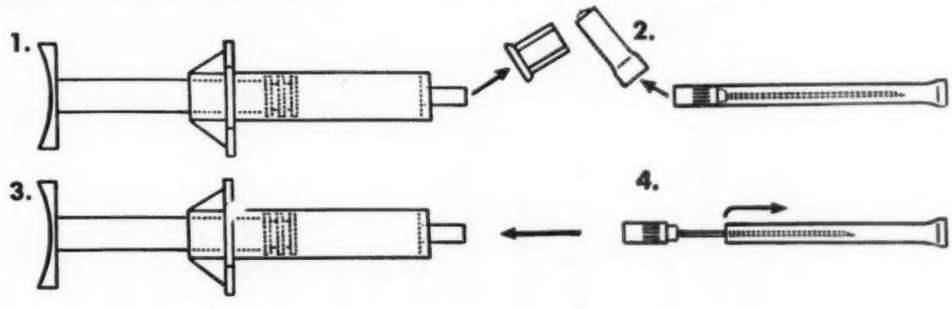

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Sixty-first Year of Publication

VOL. LXXXIV AUGUST, 1952 NUMBER TWO

Editorial

MINES BUREAU SHOWS WAY TO CURB OPERATING ROOM EXPLOSIONS

WE received permission from Allan Sherman, Chief of the Office of Minerals Reports, United States Department of the Interior, Bureau of Mines, to reproduce their release under the title we have used at the head of this editorial. Without more ado, we quote in full:

"Simple and practical methods for preventing accumulations of static electricity in hospital operating and delivery rooms, thus lessening the chances of anesthetic explosions, are described in a Bureau of Mines report made public by Secretary of the Interior Oscar L. Chapman. The report covers special research conducted by the Bureau which confirmed the effectiveness of measures already used in many hospitals and which resulted in the development of additional safeguards for curbing the dangers of static electricity, the leading cause of anesthetic explosions.

"A series of explosions in Eastern hospitals in 1948, some of them fatal to patients, caused the Bureau to launch a thorough study of operating and delivery room explosion hazards. The report released by the Federal agency describes conditions found during this study and lists suggested corrective measures. It is based upon intensive research at fourteen hospitals selected as representative with respect to size and types of operations performed.

"Unlike power electricity, static electricity 'builds up' on materials which do not carry power electricity. When the accumulation of static electricity becomes sufficiently great, a spark may result. While harmless from a shock standpoint, this spark of static electricity sometimes is sufficient to ignite explosive atmospheres created by the use of anesthetics. The Bureau's research is aimed at preventing anesthetic explosions by erasing conditions that permit creation and 'build up' of static electricity charges.

"Recommendations in the Bureau's report range from such simple expediencies as spreading wet towels on the floor and letting them touch the bases of operating tables and anesthesia machines, to far reaching changes in equipment and furnishings and the exclusive use of cotton uniforms and gowns by all persons on duty during the administration of anesthetics. Tests confirmed that synthetic fabrics have a strong tendency to 'manufacture' static electricity. There probably is no combination of equipment and activity anywhere more likely to produce dangerous charges of static electricity than that found in the anesthetizing areas of most hospitals of the nation, the report says. When conditions are favorable, the static sparks become intense enough to ignite gases or vapors escaping into the room air—and an explosion results. Many of the mixtures used for anesthesia are rich in oxygen and are easily ignited by static sparks of low energy.

"Although the interest of the Bureau of Mines in the explosibility of anesthetic gases is not new, the most recent study centered

largely on the nature, prevalence and danger of static electricity where anesthetic gases are administered patients. Dozens of tests were made under varying conditions in a total of seventy-eight operating rooms, twenty-two delivery rooms and sixteen typical hospital corridors. Floors, tables, rolling equipment, shoes and clothing of employees, blankets, towels—all were tested to determine their relative safety. If they tended to build up charges of static electricity, they were labeled as unsafe.

"Authors of the report are Paul G. Guest, electrical engineer; V. W. Sikora, physical science aide; and Dr. Bernard Lewis, Chief of the Explosives and Physical Sciences Division of the Bureau in Pittsburgh to which Guest and Sikora are assigned. Dr. Lewis is now on a year's leave with the Ordnance Corps, Department of the Army. The Bureau men held frequent consultations concerning certain aspects of the research with Dr. George J. Thomas, head of the Department of Anesthesiology, University of Pittsburgh. Wholehearted cooperation was given by the participating hospitals.

"The study resulted in some startling disclosures. It was proved that an operating table can collect a charge of static electricity simply by removing a sheet from the rubber-covered mattress. In one case speedy removal of a sheet from a mattress indicated a charge potential of no less than 9,000 volts. While a static electricity charge of 9,000 volts would cause only a slight stinging sensation to a person, its spark could ignite an explosive mixture in an operating room, the Bureau reported. Several carriages drawn along a delivery suite corridor of a hospital acquired dangerous charges of static electricity from the rolling of the tires on the floor. Another carriage acquired a dangerous charge when its rubber-covered mattress was rubbed either with a sheet or a woolen blanket. However, the charge failed to develop if the carriage was touched (grounded) during the charging by a person wearing leather-soled shoes. When a sheet or a blanket was taken off the carriage and tossed on a rubber-footed metal stool, charges of static electricity were transferred to the stool.

"Various methods of grounding were tested. One table was charged to a potential of 5,000 volts by removing a sheet or blanket. Illustrating a simple grounding method (suitable for use where conductive floors have not yet been installed), when a wet towel was placed on the floor with the end draped over one of the casters, the voltage indicated was zero.

"A total of 150 tests were made on operating and delivery room employees under different conditions, either while walking or simply scuffing around, or even rising from a stool covered with artificial leather. One person with rubber shoes, walking on a linoleum floor, developed a charge potential of 1,500 volts—enough static electricity to ignite an explosive mixture. A person wearing a woolen suit, rising from a stool covered with artificial leather, also created a dangerous charge of static electricity.

"The Bureau's report thus suggests that floors, rubber shoes, covers and other materials be made conductive so creation of static electricity will be avoided. Cotton was found to be the best material for uniforms.

"Containing many graphs, charts and photographs, the report offers ten specific recommendations for improving safety and reducing explosion hazards in operating and delivery rooms where anesthetic gases are used. Recommendations concern blankets, sheets, pillows, mattresses, pads, shoes, breathing tubes, face masks, bags, floors, stools and tables, casters, carriage-wheel tires, leg tips, garments, receptacles, electric plugs and outlets, and suggest that hospitals obtain equipment for testing the electrical transmission characteristics of shoes worn by hospital attachés.

"A free copy of Report of Investigations 4833, "Static Electricity in Hospital Operating Suites; Direct and Related Hazards and Pertinent Remedies," can be obtained by writing the Bureau of Mines' Publications-Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa."

We sincerely hope that directors of surgery, attending surgeons, directors of anesthesiology and operating room supervisors will send for a copy of this report.

T. S. W.

Original Articles

NEEDLE BIOPSY OF THE LIVER*

AN ANALYSIS OF 308 CASES

JOHN M. RUMBALL, M.D.
Coral Gables, Florida

IT is becoming apparent that needle biopsy of the liver has found its place in our armamentarium of diagnostic procedures. The laboratory tests in the form of "liver profile" will never be replaced by needle biopsy of the liver. These tests are needed in order to make the picture complete and in following the progress of the disease. The liver function tests give information regarding the liver similar to what one gets by studying the peripheral blood in hematologic disorders, whereas examination of tissue removed at needle biopsy is likened to an examination of the bone marrow.

Very little is found in the surgical literature on this procedure. The surgeon is faced with the problem of jaundice almost as often as the internist. Prior to examination of needle biopsy tissue these two groups often had healthy disagreements regarding the cause of jaundice in individual cases. By adding the histologic examination to the multitude of "liver function" tests, these disagreements are becoming less frequent. In some instances patients have been saved the unnecessary surgical procedures for either thoracic or abdominal carcinoma when it was possible to pick up a metastatic lesion in the liver by the needle biopsy.

At this Veterans Administration Hospital we have done 308 needle biopsies of the liver on 280 patients from January, 1947, to August, 1951. The experience gained by reviewing this number of needle biopsies led to the analysis of our results. The historical background and review of the literature will not be given inasmuch as this has been adequately covered by other authors.[1,2]

Method. The type of needle and the method used seem to be of little significance as long as the operator is careful in the selection of patients, observing the contraindications and is careful in his technic. At our hospital we have done fifty-seven biopsies by the subcostal approach and 251 by the transpleural or intercostal approach. The latter method is preferred unless the liver is markedly enlarged and a definite nodular area is chosen as the site for biopsy. The technic used for the transpleural approach is essentially that used in most institutions. Under sterile technic with the right lateral chest sterilized with merthiolate, an area is selected either at the anterior axillary line or midway between the anterior and mid-axillary line in the seventh or eighth interspace. One per cent procaine is instilled into the skin, subcutaneous tissue and the intercostal muscle. With a longer needle still more procaine is instilled into what should be the diaphragm and Glisson's capsule. At times some procaine will be instilled into the hepatic substance itself. A small incision is made with a No. 11 Bard-Parker knife in order to facilitate the introduction of the Vim-Silverman needle. The stylet of the Vim-Silverman needle is not used; however, the forked obturator is inserted in a such a position that its tip is just out of vision at the distal end of the carrier needle. The carrier needle is then inserted into the intercostal muscle, at which point the patient is asked to take a deep breath, exhale and hold his breath. The needle is inserted a distance of approximately 5 cm. and the inner forked needle is then pushed firmly into the liver substance. This is followed immediately by advancing the carrier needle over the forked needle, after which it is turned about 180 degrees and both needles withdrawn. The

* Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions drawn by the author are the result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

whole procedure should not take longer than five seconds. After the needle is withdrawn, the inner forked needle should contain a specimen of liver tissue measuring from 1 to 2 mm. in diameter and 1 to 3 cm. in length. If a specimen is not obtained on the first attempt, several more attempts can be made without detriment to the patient. This procedure has been carried out in the operating room because of administrative reasons; however, it can be done at the bedside. Each patient has received 10 mg. of vitamin K (three times a day orally) prior to the biopsy regardless of the prothrombin time. Just before going to the operating room the patient is given 1 to 2 gr. of sodium luminal by hypodermic. The tissue obtained at biopsy is placed in either Carnoy's solution when special glycogen stains are required or in Bouin's solution. The number of failures that occurred with this method has been less than 2 per cent.

Indications. In general it can be stated that needle biopsy of the liver is of definite benefit in any patient suffering with primary liver disease, which may include the following conditions: (1) to differentiate between parenchymal and extrahepatic biliary obstruction, (2) cirrhosis of the liver, (3) hepatitis and (4) hepatomegaly of undetermined cause.

Needle biopsy of the liver is also indicated in some of the following systemic diseases or diseases in which the liver is involved secondarily; (1) pulmonary and abdominal malignancies, (2) systemic diseases, (3) systemic diseases unrecognized such as tuberculosis, sarcoidosis and brucellosis.

The contraindications involving this procedure, although few, must be strictly observed. Briefly these contraindications are as follows: (1) Patients in whom there is some disturbance of coagulation of blood, including an abnormal prothrombin time, should not be subjected to this procedure. We have arbitrarily set the upper limits of safety at twenty-five seconds. We have hesitated doing needle biopsy of the liver in patients with various types of leukemias since depressed platelet count is often present. With the exception of a death that is reported elsewhere in this paper, no detectable hemorrhage has occurred in this series thus far. (2) The presence of abdominal ascites makes needle biopsy of the liver very difficult and often impossible because the fluid seems to accumulate between the diaphragm and the liver making this organ quite mobile, so that when the needle strikes the liver it is pushed aside. In addition to this compression of the leaf of the diaphragm over the liver after biopsy, which probably often prevents hemorrhage, does not occur; therefore, the danger of hemorrhage is greater. Abdominal paracentesis can be carried out a few hours before the needle biopsy is done so that the mere presence of ascites is not a contraindication in the strict sense of the word. (3) This contraindication has been reported by others, and we have had experience in attempting needle biopsy of the liver in patients who have some pulmonary disease involving the right lower lung or right pleural cavity. A needle biopsy was done in a patient who later was found to have endothelioma of the pleura. A severe pleural reaction occurred after this biopsy. (4) Any patient who is unable to cooperate by holding his breath at the proper time should not be subjected to this procedure.

TABLE 1

DIAGNOSES MADE ON 308 NEEDLE BIOPSIES

Acute viral hepatitis (S.H. and I.H.)		26
Acute fulminating toxic hepatitis		2
Extrahepatic biliary obstruction		12
"Chronic" hepatitis (cholangiolytic and recurrent hepatitis)		6
Cirrhosis of the liver—all types		152
Early cirrhosis (mostly fatty livers)	29	
Moderately advanced cirrhosis	42	
Far advanced cirrhosis	54	
Cardiac cirrhosis	5	
Posthepatitic cirrhosis	19	
Hemachromatosis	3	
Primary carcinoma		4
Metastatic carcinoma		26
Extramedullary hematopoiesis (agnogenic myeloid metaplasia)		4
Tuberculosis (hematogenous) of liver		1
Normal—all indications		66
Abnormal tests and/or hepatomegaly	14	
Normal tests and hepatomegaly	15	
Systemic disease (mostly pulmonary tuberculosis)	37	
Unsuccessful biopsies—no tissue		4
Unsatisfactory tissue		5
Total		308

Table 1 indicates the histopathologic diagnosis made in this series of 308 biopsies. In some instances an accurate diagnosis would not have been made without the needle biopsy; however, in most instances the needle biopsy confirmed the clinical impression and was of definite value from the standpoint of evaluating the degree of hepatic damage in attempting a

prognosis as to the ultimate outcome as well as the duration of strict therapy. In some instances a repeat needle biopsy was done to follow the progress of the disease and enable us to evaluate the therapy.

The following case reports are cited with illustrated photomicrographs of the needle biopsy and are chosen to emphasize the value of examination of the liver by this method in various pathologic states.

CASE REPORTS

CASE I. L. L., aged twenty-seven, was admitted to this hospital in June, 1949, with a history of loss of appetite, general malaise and an ache in the right upper quadrant of the abdomen as well as the epigastrium. These symptoms had been present for about four or five days prior to admission. During this time the urine had been dark in color. The day before admission the patient noted an icteric tinge to the skin and scleras. He gave no history of previous episodes of jaundice nor of any recent injections including receiving plasma or transfusions. Examination revealed this patient to be moderately icteric. The liver was palpable about three finger breadths below the costal margin and the liver profile revealed a 3 plus cephalin flocculation, a serum bilirubin of 5 mg, a thymol turbidity of 25 units with normal total cholesterol and cholesterol esters; the alkaline phosphatase, total proteins and albumin-globulin ratio were also normal. A clinical diagnosis of acute hepatitis was made. A liver biopsy was done one week after admission and is illustrated in Figure 1. The liver biopsy in this case was not necessary for the diagnosis inasmuch as the history, findings and laboratory tests all indicated that this was the usual acute infectious or viral hepatitis. However, in other instances, particularly acute hepatitis without jaundice, the needle biopsy is of extreme value. In this series there are three such cases.

CASE II. F. S., a seventy-six year old white male, was admitted to this hospital in October, 1949, stating that he had been in a fair state of health until approximately ten days before his admission. The illness began with an attack of pain, nausea and vomiting. The pain was located in the epigastrium and seemed to be aggravated by eating. Five days prior to his admission jaundice was noted. Examination revealed an icteric patient with the palpable liver down about two fingerbreadths below the costal margin on the right. There were no other palpable organs nor any palpable masses in the abdomen. The liver profile revealed a cephalin flocculation of 1 plus and a thymol turbidity of 1.3 units. The serum bilirubin was positive direct; the total bilirubin was 26.6 mg. per cent. The alkaline phosphatase was 16.5 Bodansky units. Urinalysis revealed urobilinogen in a 1:10 dilution by the Wallace and Diamond method. The clinical impression was that this patient had extrahepatic biliary obstruction, most probably due to carcinoma of the head of the pancreas. Needle biopsy of the liver was done, which indicated extrahepatic biliary obstruction. Figure 2 shows numerous bile thrombi surrounding the central vein. This is a very typical picture of this condition. Here again the needle biopsy of the liver was not necessary and surgery would have been performed without the information gained by the needle biopsy; however, with this additional information it left no doubt as to the cause of the jaundice. Operation was performed and this patient was found to have carcinoma of the head of the pancreas.

CASE III. D. P., aged thirty-five, was admitted to this hospital on May 26, 1950. He was seriously ill upon admission, and complained of severe weakness and anorexia for a period of two months. Nausea and occasional vomiting had been present for one month prior to admission; severe pain over the right upper quadrant and right lower chest associated with fever was noted one week prior to admission. He gave a history of excessive indulgence in alcoholic beverages in addition to poor dietary habits. It was not possible to feel the liver edge because of muscle guarding in the upper abdomen; however, it was felt by percussion that the liver was enlarged approximately three fingerbreadths below the costal margin. The tongue was smooth and red and there were multiple spider angiomas on the anterior chest and shoulders. The spleen could not be palpated. The clinical impression was that of possible cirrhosis of the liver; however, because of the patient's critical condition, fever, leukocytosis and weight less the positive diagnosis was not possible even with the following liver profile: The cephalin flocculation was 3 plus, the thymol turbidity 1.8 units, total serum bilirubin 0.90 mg. per cent bromsulphalein, 21.5 per cent retention and the alka-

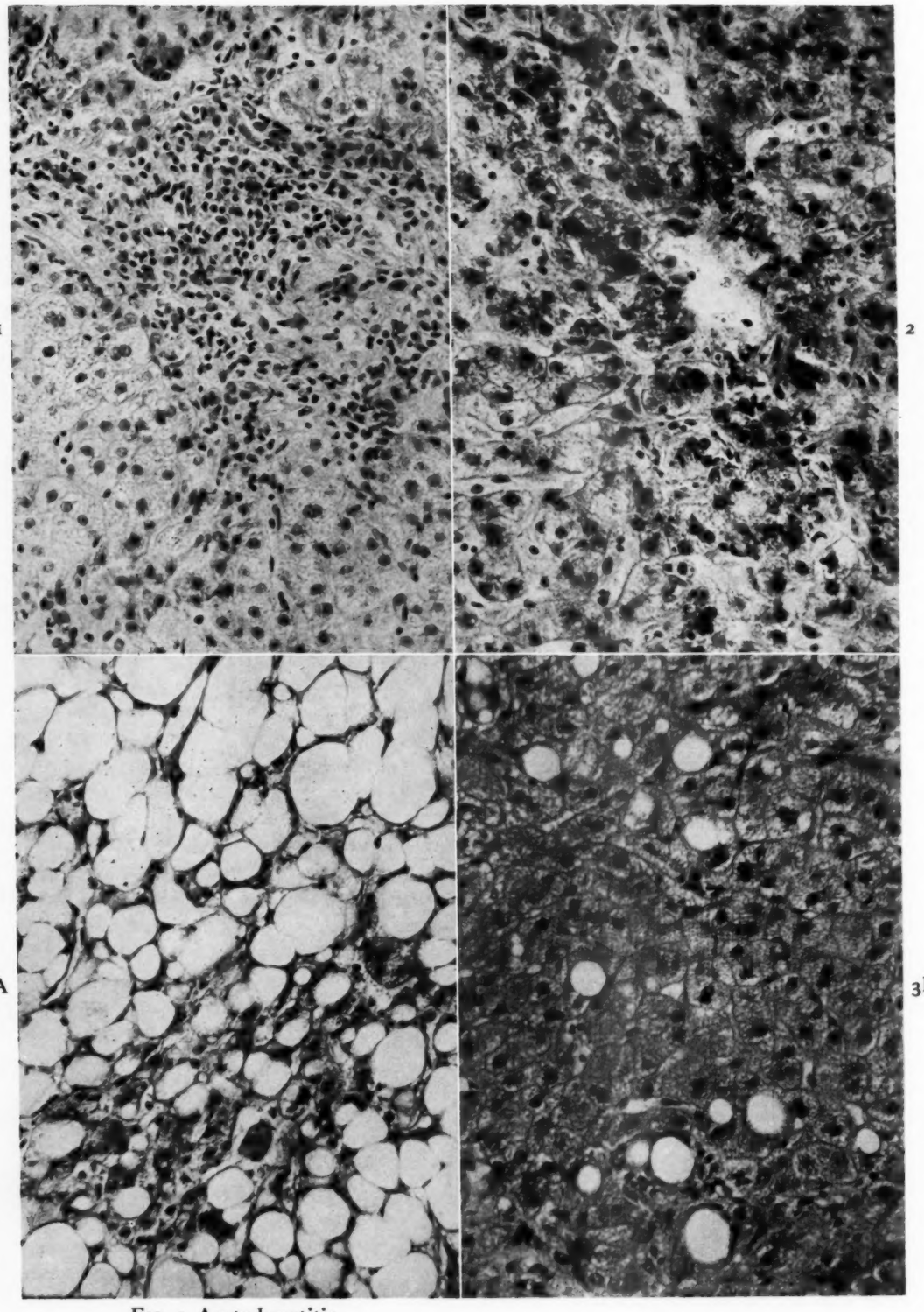

Fig. 1. Acute hepatitis.

Fig. 2. Extrahepatic biliary obstruction.

Fig. 3. A, cirrhosis with fatty replacement; B, after six weeks of therapy.

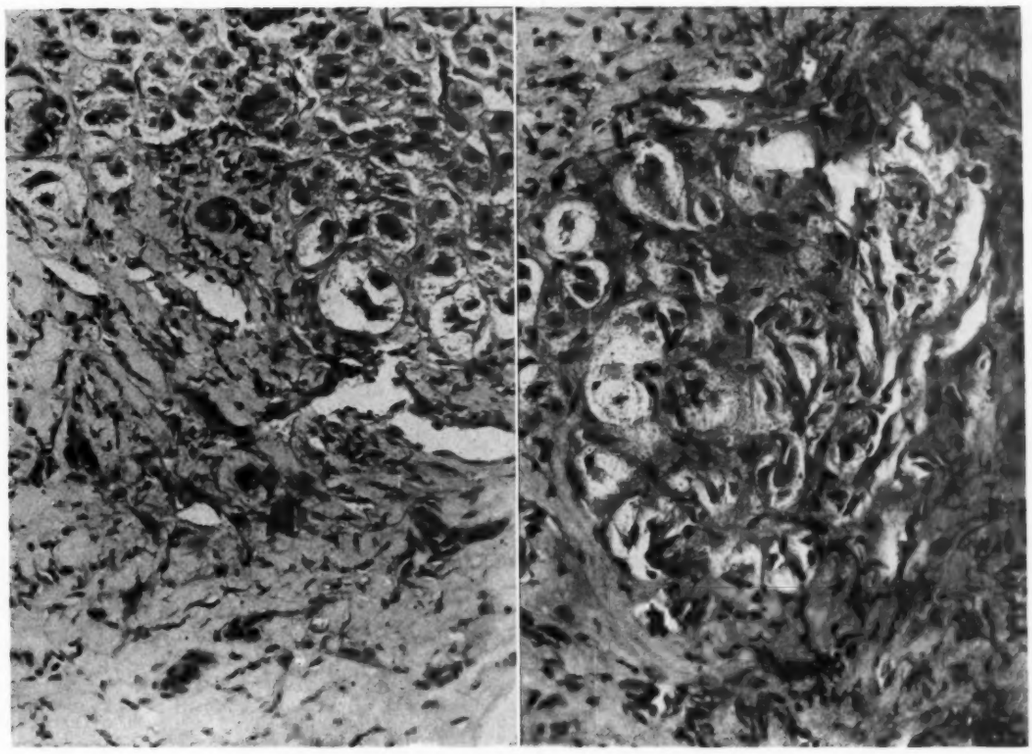

FIG. 4. Far advanced posthepatitic cirrhosis.

FIG. 5. Far advanced cirrhosis.

line phosphatase 13.9 Bodansky units. A needle biopsy was done approximately one week after the patient was admitted to the hospital and is illustrated in Figure 3A, which shows striking obliteration of the usual lobular pattern. There was marked fatty metamorphosis, and in addition there was some neutrophilic and lymphocytic infiltration as well as increased bile duct proliferation. After one month of therapy, consisting of adequate dietary intake, lipotropic substances and aureomycin in dosage of 500 mg. every six hours,[15] a second biopsy was taken. (Fig. 3B.) A striking decrease in the fatty infiltration and some restoration of the normal hepatic parenchyma were shown. This illustrates the value of biopsy in establishing a diagnosis and the value of several biopsies to visualize progression or regression of the pathologic changes. This patient returned to the hospital one year after discharge after having been drinking excessively, eating poorly and working long hours as a cook. A third biopsy was done and again showed marked fatty infiltration. The patient again responded to adequate diet and rest.

CASE IV. V. L., aged twenty-seven, contracted acute infectious hepatitis in February, 1945. He did not recover from the acute illness but remained continually icteric. In July, 1946, an exploratory operation was performed because of the possibility of overlooked biliary calculi. No disease of the biliary tract was found at operation. He remained icteric for a period of approximately four years and was hospitalized several times during this period. Figure 4 shows the needle biopsy of the liver taken in January, 1949, which is illustrative of the so-called posthepatitic cirrhosis. This case has been reported elsewhere.[15] In this instance the needle biopsy aided in giving a clear-cut picture of the degree of liver damage and also acted as a baseline by which to judge histopathologic improvement after therapy.

CASE V. J. W., aged thirty-seven, was admitted to this hospital in May, 1950. This patient was a former Funeral Director and during World War II worked in a hospital laboratory in England. In 1943 he was jaundiced for a period of two to three weeks; however, he did not report for Sick Call but continued to work. There is no record of this in his Army file. He had always used alcoholic

beverages to excess (but was not considered by his brother, who is a physician, to be a chronic alcoholic). In 1931 he was treated with bismuth and arsenic for about a year and a half because of primary syphilis. He had his second course of fifty injections because of a positive Kahn reaction. This reaction has never become negative.

For the previous two years this patient had been told by his friends that he looked yellow. He was admitted to the hospital because of edema of the lower extremities for three weeks in addition to fever of three weeks' duration. The urine had been dark in color; however, the stools were not clay-colored. Examination revealed a moderately jaundiced white male who showed innumerable spider angiomas over the anterior chest and neck, shoulders and posterior chest. There was palmar erythema. The liver was enlarged about three fingerbreadths below the costal margin on the right. It was somewhat tender to fist percussion. There was a suggestion of abdominal ascites. The spleen could not be felt. Although the patient was not drowsy or comatose, his breath had the typical fetor hepaticus. Laboratory examination revealed normochromic microcytic anemia; the cephalin flocculation was 4 plus, the prothrombin time 55 per cent of normal and the cholesterol 187 mg. with 75 mg. cholesterol esters. The serum bilirubin was 3.7 mg. per cent, thymol turbidity 11.6 units and alkaline phosphatase 7.5 Bodansky units. Total protein was 7.1 gm. with 2.41 albumin and 4.69 gm. globulin. After three months of hospitalization consisting of bed rest, high protein diet, crude liver extract, etc., there was very little change in the liver function tests. The cephalin flocculation still remained at 4 plus, thymol turbidity was 17 units and the total cholesterol was 227 mg. per cent with a cholesterol ester of 96 mg. per cent. The prothrombin time was 68 per cent of normal and the alkaline phosphatase was 13.4 units. The total serum bilirubin was 2 mg. per cent. During this time the anemia was corrected.

Needle biopsy of the liver was done after three weeks of hospitalization as illustrated in Figure 5. This shows considerable fibroblastic activity with bile duct proliferation; small nests of hepatic cells are compressed by connective tissue proliferation. This illustrates the end stage of cirrhosis of the liver as well as the end stage of several types of hepatic damage, which in this case may be (1) chemical, (2) infectious and (3) nutritional. It is impossible from the appearance of this needle biopsy to tell the original cause of the cirrhosis of the liver. However, the needle biopsy gives us a definite picture and adds to the prognosis, which in this case is not good.

Case VI. W. D., aged fifty-six, was admitted to this hospital in September, 1949, because of weakness, shortness of breath and swelling of the lower extremities of about three months' duration. Past history revealed that thirty years prior to admission the patient had worked in a copper mine in South America, at which time he became heavily tanned from the exposure to sunlight. He returned to the United States a few years later. This tan never completely disappeared and his skin was always darker than it had been prior to his stay in South America. He remained in good health and was physically qualified to enter the U. S. Navy in 1943; however, he was discharged in 1944 because of recurrent episodes of anterior chest pain. Subsequently he was service-connected 100 per cent for arteriosclerotic heart disease. In 1946 diabetes developed which at first was regulated by diet alone but later required insulin. Examination revealed a thin, emaciated, dusky-appearing white man who appeared older than his stated age. The skin showed a grayish brown pigmentation over the entire body, more prominent in the axilla and about the groins. The liver was palpable about three fingerbreadths below the right costal margin. There was marked palmar erythema. Moderate pitting edema was noted over the entire lower extremities. Skin and liver biopsies were done one week after admission. The liver biopsy shown in Figure 6 illustrates the typical hemosiderin deposits as brought out by the special Prussian blue stain, characteristic of hemochromatosis. The skin biopsy also showed evidence of hemosiderin pigment. This patient expired two months later and the diagnosis was confirmed at autopsy, there being involvement of almost every tissue in the body, including the heart. In this case the skin biopsy was sufficient to make the diagnosis; however, the needle biopsy of the liver greatly augmented this diagnosis.

Case VII. D. M., a fifty-one year old white man, was admitted to the hospital in June, 1948, because of severe pain in the left heel

and left foot. On examination he appeared chronically ill and as though he had lost considerable weight. There was moderate anemia as well as marked enlargement of the left lobe of the liver. The right lobe descended about two fingerbreadths below the costal margin. X-ray of the left foot revealed an osteolytic area in the os calcis, measuring approximately 4 by 6 cm. There was also another small area of decreased density in the astragalus. No other bony defects were seen in the spine, ribs or right foot. Gastrointestinal x-rays, including barium enema, were normal. Figure 7 illustrates the histologic picture of the specimen obtained at needle biopsy and was diagnosed as carcinoma of the liver. One could not tell that this was primary carcinoma of the liver, but it was diagnosed as such because no other primary site had been found. This patient eventually expired. Autopsy revealed primary carcinoma of the liver. The lesion in the left heel was a bony metastatic lesion. In this instance the needle biopsy of the liver gave the correct diagnosis. It is interesting to note that primary carcinoma of the liver frequently metastasizes to the bone. The needle biopsy in this case was done by the subcostal method over an area that appeared to be nodular in the left lobe of the liver.

Case VIII. F. W., aged sixty-two, was admitted to this hospital in February, 1949. He gave a one-month history of productive cough, wheezing respiration and exertional dyspnea, and one week before admission he had coughed up blood-streaked sputum. X-ray of his chest revealed an irregular, enlarged, right hilar mass. A bronchoscopy was done and it was the opinion of the bronchoscopist that this patient had carcinoma involving the right main stem bronchus; however, the pieces removed at biopsy were negative.

In addition to the pulmonary findings on physical examination, namely, the scattered wheezes throughout the right chest, the liver was felt to be enlarged about two fingerbreadths below the right costal margin. This patient was sent to the Surgical Service for exploratory thoracotomy; however, before this was done needle biopsy of the liver was accomplished. Figure 8 shows the appearance of the tissue removed at biopsy. This shows areas in which the hepatic parenchyma are replaced by collections of undifferentiated small neoplastic cells suggesting bronchogenic origin. This case illustrates the example whereby a patient can be prevented from undergoing unnecessary surgical procedures for carcinoma if metastases to the liver can be demonstrated. It is perfectly obvious that a negative biopsy is insufficient proof that metastases to the liver do not exist.

Case IX. L. M., aged fifty-four, was admitted to this hospital in January, 1950, because of cough, weight loss and edema of the lower extremities. The chest revealed multiple dense infiltrations in the left lung with large cavitations in the upper lobe. There were also nodular infiltrations throughout the right lung field. The patient was seriously ill and it was thought he had a tuberculous miliary spread. A liver biopsy was done in February, 1950, and showed several typical tubercles. (Fig. 9.) Because of the proven hematogenous dissemination more rigorous therapy with streptomycin and PAS was instituted.

Case X. J. K., aged sixty-five, was admitted to the hospital December 7, 1950, because of cellulitis of the scrotal area secondary to irritation from a truss worn for a right inguinal hernia. Examination revealed an enlarged spleen and liver in addition to the admitting diagnosis. The white blood count was 20,000 with many myelocytes and metamyelocytes. There were also normoblasts in the smear. Later the white blood count returned to 9,000 and 14,300, still showing many early forms. A diagnosis of possible leukemia was made; however, the bone marrow examination revealed no fat or usual bone marrow arrangement. There were scanty cells in the marrow, all early forms, but less than in the peripheral blood. From this a tentative diagnosis of myeloid metaplasia was made. A liver biopsy (Fig. 10) revealed nests of blood elements in the liver and the sinusoids filled with peripheral blood elements showing the liver had reverted back to its embryonic activity of blood formation.

This biopsy established the diagnosis of myeloid metaplasia or extramedullary hematopoiesis.

Liver function tests showed the following: serum bilirubin 0.2 mg. per cent, cephalin flocculation 2 plus, thymol turbidity 2.2 units and prothrombin time 16.5 seconds.

Case XI. R. H., aged fifty-three, was admitted to this hospital in November, 1949. He had a three-month history of weight loss

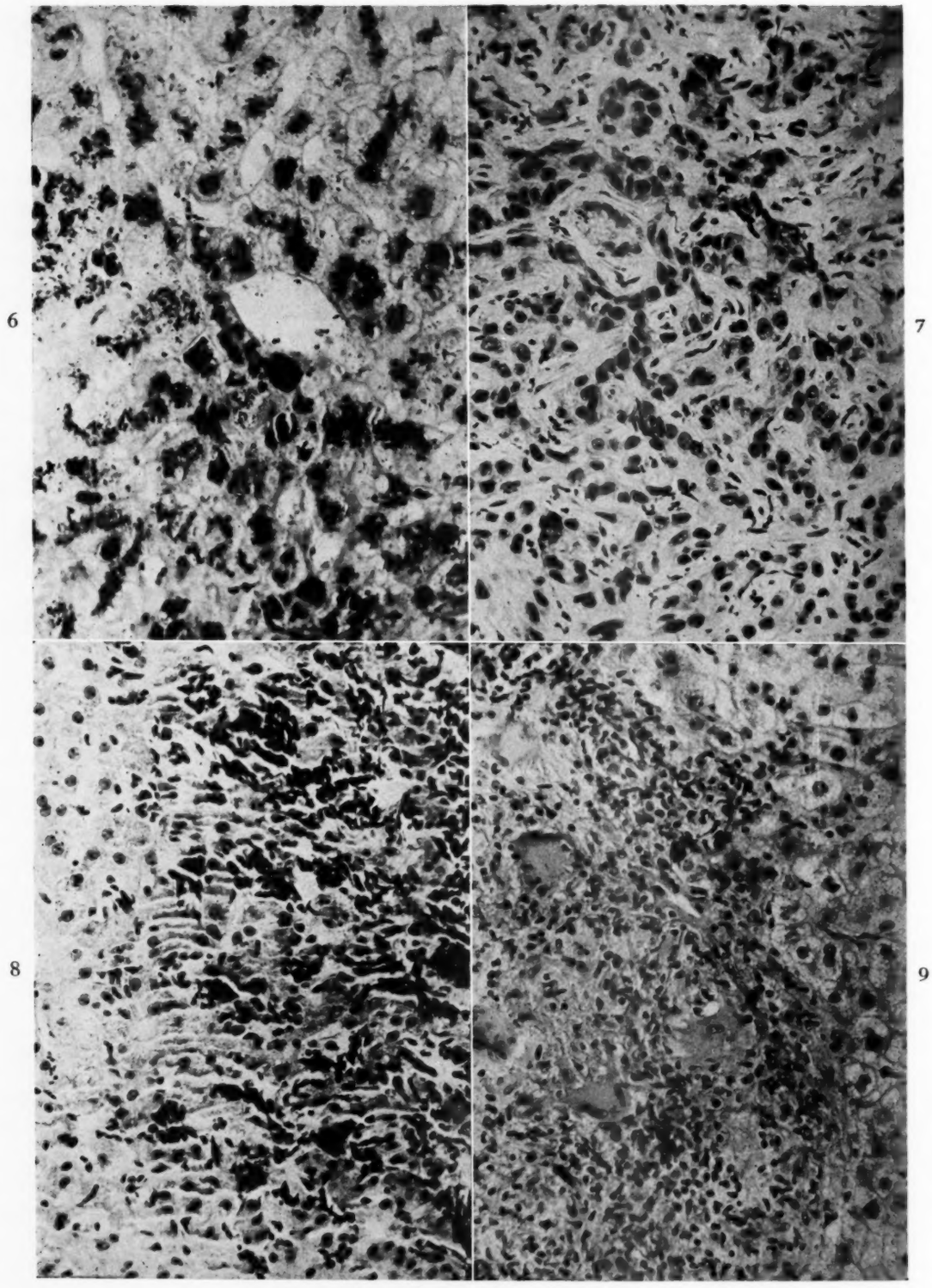

Fig. 6. Hemochromatosis.

Fig. 7. Primary carcinoma of the liver.

Fig. 8. Metastatic carcinoma of the liver.

Fig. 9. Tubercle of the liver.

and fatigue, and three weeks prior to admission he became icteric. Examination revealed a rather marked icterus and the liver profile was indicative of extrahepatic biliary obstruction as manifested by an alkaline phosphatase of 25 Bodansky units, normal thymol turbidity and cephalin flocculation with an immediate direct positive Van den Bergh test. The liver biopsy was done by the transcostal method, maintaining the usual precautions. The prothrombin time was twenty seconds. An adequate specimen was obtained, following which the patient had some discomfort over the lower right chest and right upper quadrant of the abdomen. Four hours after the biopsy he rather suddenly went into a shock-like state and shortly expired. At autopsy the small needle mark in the right lobe of the liver was seen which did not appear to be torn. There were approximately 200 cc. of clotted blood between the dome of the liver and the diaphragm. In addition there were another 250 cc. of clotted blood in the pelvis. The actual amount of blood loss was insufficient to cause death; and although several theories have been advanced, no adequate explanation is apparent. Carcinoma of the pancreas was present. This was the only death that occurred in this series of 308 biopsies. Since this death we have asked the resident physicians to record the blood pressure and pulse every hour for the first four hours after the procedure.

TABLE II
MORTALITY OF NEEDLE BIOPSIES OF THE LIVER

Author	No. of Biopsies	Deaths	Cause
Bingel (1923)	100	2	Hemorrhage
Olivet (1926)	140	3	Hemorrhage
Toullec and Huard (1935)	Not stated	1	Hemorrhage, peritonitis
Baron (1939)	48	1	Hemorrhage
Kofler (1940)	100	2	Hemorrhage
Roholm et al. (1942)	297	2	Hemorrhage
Sherlock (1945)	264	2	Hemorrhage
Raby (1944)	Not stated	2	Hemorrhage
Gillman and Gillman (1945)	507	1	Hemorrhage
Volwiler and Jones (1947)	278	1	Hemorrhage
Gallison and Skinner (1950)	Not stated	1	Bile peritonitis
Rumball (1951)	308	1	Hemorrhage
Total	2,042	19	
Additional series reported without fatalities	3,303		
Total	5,346 biopsies		
Mortality	0.36%		

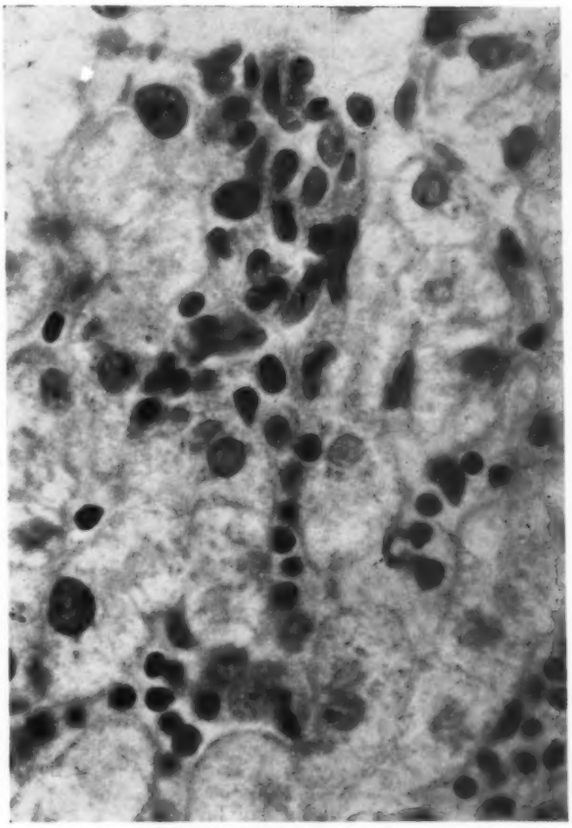

FIG. 10. Extramedullary hematopoiesis.

The mortality rate in needle biopsy of the liver was recently reviewed by Gallison and Skinner[3] in which were reported 4,911 needle biopsies done by various separate groups in which there have been seventeen deaths. All of these seventeen deaths have been ascribed as due to hemorrhage. This last case is cited to include an additional death. However, this should in no way deter from the value of needle biopsy. The mortality rate certainly is low and as more experience is gained should be much lower; however, I doubt if it would ever be without any degree of hazard. In a large series reported by Cogswell and Schiff[4] there have been no deaths.

Table II summarizes the reported mortality to date as listed by Gallison and Skinner, with the addition of the one death herein reported. It is probable that deaths have occurred which have not been reported, just as it is true that many small and moderately sized series of liver biopsy have been done in institutions that have not been recorded in the literature. A mortality rate of 0.36 per cent is hardly enough to condemn this procedure. In fact,

the mortality rate of several other diagnostic procedures such as esophagoscopy is higher.

SUMMARY

The method of performing punch biopsy of the liver, the indications, contraindications and illustrative case reports are herein cited: 308 needle biopsies of the liver have been done on 280 patients. This procedure is now a definite part of our diagnostic armamentarium in the differential diagnosis of primary liver disease and is an aid in lending light to some undisclosed conditions.

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CARDIAC ARREST DURING SURGICAL PROCEDURES*

REVIEW OF THE LITERATURE WITH A REPORT OF SIX CASES

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OF all surgical complications which occur in the operating room the most urgent is cardiac arrest. When it occurs both surgeon and anesthetist must recognize it and act instantly if a catastrophe is to be averted. The maximum time allotted for its recognition and the adoption of appropriate measures, it is said, must not exceed five minutes. More accurately, providing a much safer margin, the time limit should be no more than two to three minutes.

The first death attributed to anesthesia occurred in 1848.[1] The earliest reports on manual massage for cardiac resuscitation were the experimental studies of Schiff in 1874. There appears to be an increased frequency and, consequently, an increased awareness of this problem.[1]

Whether these patients live or die is based upon the immediate recognition of this condition and how well the entire operating personnel is trained and organized to deal with these emergencies. One such case in 3,000 to 5,000 operations is the general incidence of occurrence of this emergency. In the fifteen cases reported at the Lahey Clinic[1] the ages of the patients ranged from seven to sixty-five years.

CASE REPORTS

CASE 1. J. C., a twenty-three year old Negro, was admitted to the Jewish Hospital of Brooklyn on October 2, 1950, complaining of abdominal pain of twenty-four hours' duration associated with nausea, vomiting, anorexia and constipation, and a temperature of 102°F. The heart and lungs revealed no abnormal findings. Examination of the abdomen revealed tenderness in the right lower quadrant. The blood count and urinalysis were within normal limits. The diagnosis was acute retrocecal appendicitis.

The patient was operated upon the same evening. Spinal anesthesia was used, with a mixture of pontocaine and glucose given in L3–4 without difficulty. The level of anesthesia extended to D6. The patient was placed in slight Fowler's position, and a slow intravenous drip of 0.2 per cent pentothal sodium was started and the operation begun through a right McBurney incision. The blood pressure, pulse and respirations were normal until twenty-six minutes after anesthesia was started, at which time the anesthetist first noted the patient to be unusually pale. This observation occurred about three minutes after the peritoneum was opened. At the moment of opening the peritoneal cavity the surgeon noted the distended cecum to be darker than usual and the veins appeared distended. This observation coincided closely with the observation of pallor by the anesthetist. Approximately the next ten to twelve minutes were occupied by the anesthetist in stopping the infusion of pentothal sodium, instituting forced respiration with the anesthesia machine and giving neo-synephrine in three separate doses of 0.1 cc. each into the infusion tubing through which 5 per cent dextrose in normal saline was running. At this time the surgeon was notified that the patient was in distress. By that time the retrocecal appendix had almost been removed except for the ligation of the stump. Massage of the heart, which was felt at a standstill, was begun through the rapidly enlarged incision against the intact diaphragm for about thirty seconds. This was quickly abandoned. A rapid incision was made in the left upper quadrant and another in the left dome of the diaphragm into the chest. The heart was massaged at a rate of about 80 per minute while the anesthetist administered 100 per cent oxygen by forced respirations. Heart contractions began at first feebly and irregularly, then stronger and more rapidly. Spontaneous respirations did not begin until a half hour later, after the administration of 3 cc. of caffeine sodium benzoate intravenously. Ten

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minutes later, when respirations became more regular, a nasal endotracheal tube was passed. The patient had remained unconscious but underwent several involuntary muscular movements, twitchings and convulsive motions. During this recovery period the McBurney incision was quickly closed followed by the closure of the incision in the diaphragm and left upper quadrant.

The patient was left in the operating room until he had received 1,000 cc. of 5 per cent glucose in water and 1,000 cc. of 5 per cent glucose in normal saline. He was returned to his room, still unconscious, and placed in an oxygen tent. His blood pressure, previously normal, at this time was 135/94 and the pulse of good quality. Frequent convulsive seizures were noted. The left chest was percussed and found hyperresonant with the heart in the midline. The left chest was aspirated and 500 cc. of air removed to reduce the pneumothorax in an attempt to relieve an already embarrassed heart. A Levin tube with Wangensteen suction was passed to relieve gastric distention. A whole blood transfusion of 500 cc. followed with 5 per cent glucose in saline was administered. Aspiration through the endotracheal tube was performed to remove any tracheal secretions. The patient remained unconscious with rapid, stertorous respirations.

Several hours later his temperature rose rapidly. The following morning his condition was poor, the pulse 160 per minute and thready, respirations labored and the blood pressure 90/70. The patient's temperature had gone rapidly to 108°F. Early that afternoon his pulse was 140 per minute; the temperature dropped to 104°F. and he died.

Comment. This case illustrates the occurrence of cardiac arrest in a young healthy individual who underwent a simple operative procedure. What initiated the cardiac arrest is difficult to establish with certainty. Many precious minutes were lost before the condition was recognized by the anesthetist and by his attempt at revival before the surgeon was notified and cardiac massage instituted. The fact that the patient was revived, in spite of this time loss, and lived for about sixteen hours makes one believe that had cardiac massage been started much sooner the patient might have recovered. More minutes might also have been saved by the more direct approach to the heart through the left chest wall.

CASE II. J. L., a thirty-two year old Negro, was admitted to the Jewish Hospital of Brooklyn on October 11, 1950, complaining of pain in the right lower quadrant associated with nausea of four hours' duration. He had been rejected by the army because of rheumatic fever. On physical examination the patient appeared acutely ill and very apprehensive. His temperature was 101.2°F., pulse rate 116 per minute and respirations 20 per minute. The blood pressure was 165/115. Examination of his heart revealed a presystolic apical murmur. The abdomen appeared somewhat distended, with marked spasticity and direct and rebound tenderness in the right lower quadrant. Rectal examination disclosed tenderness toward the right side. The blood count showed 19,000 white blood cells. The diagnosis was acute appendicitis in a patient with rheumatic heart disease.

The patient was premedicated at 8:30 P.M. with 1/6 gr. morphine sulfate, 1/150 gr. scopolamine and gr. ii sodium phenobarbital because he was extremely nervous. He was wheeled into the operating room at 9:15 P.M. Spinal anesthesia was administered at 9:40 P.M. through L3 with the table level, using 12 mg. of pontocaine with glucose.

A lower right rectus incision was made at 9:46 P.M. At 10:00 P.M., while the acute retrocecal appendix was being visualized, the patient, who had been garrulous up to that time, suddenly quieted down and began to roll his head from side to side. At this moment the anesthetist was unable to obtain blood pressure or pulse and respirations ceased. The surgeon was immediately notified and found an absence of aortic pulsation and also of a heart beat through the diaphragm. Immediate incision was made through the left chest exposing the heart in a matter of two minutes. The heart was not beating and cardiac massage was begun while the anesthetist gave artificial respiration with the anesthesia machine. After several minutes fibrillar twitchings were observed. Twenty cubic centimeters of 1 per cent procaine were injected into the left ventricle and cardiac massage was continued. Fibrillation continued for about fifteen minutes and then all contractions of the heart stopped. Massage was continued for twenty minutes longer but the heart did not revive.

Comment. Whether the marked psychic element noted in this patient preoperatively

had anything to do with the cause of his cardiac arrest is a matter of conjecture. This also applies to the presence of rheumatic heart disease which was not severe and was not associated with any degree of decompensation. Surely patients with far more severe cardiac disease are constantly being operated upon with successful outcomes. The anesthesia was administered by a trained doctor anesthetist who was aware of the possibility of this unfortunate mishap, and therefore no time was lost, as in the previous case, before the surgeon was informed and cardiac massage instituted. An electric defibrillator was not available to combat the ventricular fibrillation which undoubtedly was the cause of death.

This case is similar to the one reported by Roualle[16] whose patient lived only four hours.

Case III. J. M., a fifty-six year old man, was admitted on January 1, 1951, to the Jewish Hospital of Brooklyn because of abdominal pain and vomiting. The pain was sudden in onset and became more localized to the left lower quadrant. Four weeks before admission he noted the presence of rectal tenesmus and alternating constipation and diarrhea with small amounts of blood in the stool.

He had had an appendectomy in 1916 and a cholecystectomy in 1944. He had a history of several coronary occlusions. His last two coronary episodes were ten weeks and four weeks before admission.

On admission the patient's temperature was 102.2°F., pulse regular at 96, blood pressure 110/70 and respirations 32. He was moderately dyspneic and orthopneic. There were bilateral basilar murmurs. The abdomen showed slight distention with marked spasm and direct and rebound tenderness in the left lower quadrant. There were moderate spasm and tenderness in the right lower quadrant and marked costovertebral angle tenderness on the left.

Laboratory data revealed the following: Urinalysis was negative and hemoglobin was 104 per cent; there was mild leukocytosis. The blood sugar was 139 mg. per cent, urea nitrogen 28, carbon dioxide 56 volumes per cent, chlorides 332 mg. per cent, total protein 5.6, albumin-globulin ratio 1.9. The impression was that the patient had localized peritonitis due to acute diverticulitis of the sigmoid, possibly with perforation, or a perforated neoplasm of the sigmoid.

Because of the patient's poor cardiac status conservative therapy was instituted. He was fed by infusions and given antibiotics and digitalis. He responded well and his pain and tenderness became sharply localized to the left lower quadrant. He continued to improve and by January 5th was taking a diet by mouth. An electrocardiogram showed myocardial damage and intraventricular conduction disturbance. X-ray studies of the abdomen showed considerable gaseous distention of the entire colon. A barium enema showed a constriction at the upper sigmoid suspicious of an organic lesion with slight dilatation of the bowel proximal to this.

On January 13th the patient was taken to the operating room. The anesthesia was nitrous oxide and cyclopropane supplemented by pentothal sodium, curare and oxygen. Anesthesia began at 8:15 A.M. and operation began at 8:35 A.M. Laparotomy was performed through a lower left rectus muscle-splitting incision. Just above the peritoneal reflexion in the lower sigmoid a carcinoma could be palpated within the bowel. This had not extended into the serosa. The wound was closed and a right upper quadrant transverse incision was made and a loop colostomy performed. The operation ended at 9:42 A.M. with the patient evidently not in any unusual difficulty. At 9:55 A.M. as he was about to be moved onto the stretcher his eyes rolled up, breathing was in gasps and pulse and blood pressure were unobtainable. The chest was opened and the heart was found stopped and dilated. Cardiac massage was started at 10:00 A.M. and adrenalin given into the right ventricle. Procaine, 100 mg., and pronestyl, 500 mg., were given intravenously. At 10:30 A.M. 0.5 cc. adrenalin was again given into the right ventricle. Spontaneous cardiac action started at 10:06 A.M. and for the next two and one-half hours varied in quality, but normal contractions never returned. At times spontaneous respirations occurred. During the entire episode endotracheal oxygen was given by intermittent positive pressure. At 11:45 A.M. the heart stopped except for occasional fibrillary twitchings, and despite three doses of 0.5 cc. 1:1000 adrenalin into the right ventricle the patient was pronounced dead at 12:35 P.M.

Comment. Two things apparently contributed to this patient's death: One was an already badly damaged heart from several previ-

ous coronary occlusions, two of them of recent occurrence, and the second was the administration of several doses of adrenalin in a patient who had received cyclopropane. Cyclopropane sensitizes the heart to ventricular fibrillation with adrenalin.

CASE IV. F. M., a twenty-eight year old white man, was admitted to the Jewish Hospital of Brooklyn on October 19, 1949, complaining of abdominal pain of three days' duration. On the day of admission he had another severe attack which radiated to the back, recurring every fifteen minutes. He had had similar but less severe attacks previously. The past history and family history were irrelevant.

On physical examination the patient appeared in acute distress. His temperature was 100.4°F., pulse 110 per minute and respirations 20 per minute. The blood pressure was 140/75. His eyes revealed slight icterus. The heart and lungs showed nothing abnormal. The abdomen was tender to palpation along the entire right side, mostly in the right upper quadrant with rigidity and rebound. The diagnosis was either duodenal ulcer with perforation or acute cholecystitis. A flat plate of the abdomen was negative for air under the diaphragm. The blood count showed 16,300 white blood cells with 72 polymorphonuclear cells. The urinalysis was normal. A mass was latter palpated in the right upper quadrant.

At operation the anesthesia was a high spinal using 1.5 cc. of pontocaine and glucose with pentothal sodium and ether-oxygen. A high right rectus incision was made. Free fluid was found in the peritoneal cavity, the omentum was thick and adherent about the liver and a large, tense, gangrenous gallbladder containing black, thick, muddy bile with numerous small and large stones was found. The gallbladder was dissected from above down and removed. Drains were inserted. Closure of the abdomen was begun but the patient was not relaxed and began to push. While more anesthesia was given, the blood pressure suddenly dropped to zero and respirations and heart beat stopped. This was recognized within thirty seconds. The hand was placed against the left diaphragm and the heart massaged several times, after which the heart started to beat again forcefully. During this time the patient was receiving oxygen through an endotracheal tube. Respirations, pulse and blood pressure all returned to normal levels. The closure was completed. During all this time the patient received 500 cc. of glucose in saline and 500 cc. of blood. The patient did well from there on and made an uneventful recovery. He was discharged on the eleventh postoperative day.

CASE V. B. D., a thirty-six year old white woman, was admitted to the E.N.T. Service of the Jewish Hospital of Brooklyn on June 10, 1951, for the removal of a cyst of the right antrum. On physical examination the patient did not appear acutely ill. Her temperature, pulse and respirations were normal. The remainder of the physical examination was negative.

The patient was taken to the operating room on the following day for a Caldwell-Luc operation. Ten per cent cocaine hydrochloride was applied to the right inferior meatus. Two per cent novocain with adrenalin was injected into the right buccogingival recess and along the infraorbital nerve and the right pterygopalatine canal. A horizontal incision was made in the right upper buccogingival recess. It was immediately noted that breathing had stopped, the pulse was not palpable and the pupils were dilated.

A doctor anesthetist was immediately called from another room. The hands of the patient were seen in carpopedal spasm. Several deep, gasping respiratory efforts were made by the patient. An intratracheal tube was passed and oxygen under positive pressure was administered. A general surgeon, on the operating room floor at the time, opened the left chest and within six to eight minutes the heart, which was flabby, was being massaged. Two cc. of novocain and adrenalin mixture were injected without improvement. One minute later another mixture of 9 cc. of 1 per cent novocain and 1 cc. (1:1000) adrenalin was injected with some improvement. A third injection of this mixture was given five minutes later. The tone of the myocardium improved and the heart began to beat spontaneously, followed within several minutes by spontaneous respirations. An infusion of 4 cc. neosynephrine in 500 cc. of saline was begun in the antecubital vein. Within ten minutes the blood pressure rose to 130/110, 140/120, 110/90, etc. The pulse, which at first was 160 per minute, diminished to 100 per minute. The color also improved. An electrocardiogram taken at this point showed a heart block which soon cleared. An intra-arterial

blood transfusion of 600 cc. was attempted and maintained for one-half hour but the patient began to show signs of pulmonary edema so this was stopped and 600 cc. of blood were removed from the femoral vein.

The following day the patient began to go gradually downhill. Through it all she had remained unconscious. The temperature was 103.2°F. The blood pressure dropped to 94 systolic and the pulse raced at 140 per minute. The respirations were 32 per minute and shallow. It was the opinion of the E.N.T. surgeon that this case was one of an idiosyncrasy to novocain, adrenalin or cocaine. The patient died at 2:30 A.M., about thirty-six hours after the onset of the cardiac arrest.

Comment. It is reasonable to assume that an idiosyncrasy to one of the drugs was the cause of the cardiac arrest. It is also realized from the events which transpired in the management of this catastrophe that much valuable time, as usual, was lost before cardiac massage was instituted. When the heart did resume its beat and respirations began, irrevocable brain damage had already taken place.

CASE VI. G. K., a seventy year old white man, was admitted to the Jewish Hospital of Brooklyn on July 23, 1951, because of diarrhea of five weeks' duration associated with dizziness and weakness. He had had several bouts of diarrhea followed by periods of normal bowel activity. X-rays taken previously showed a "growth" with obstruction. He had had a thyroidectomy in 1932 and a hemorrhoidectomy in 1930.

Physical examination revealed a man in no acute distress. The laboratory work-up was within normal limits. He was prepared for surgery on July 30th. Spinal anesthesia was given at L4 using pontocaine, glucose and epinephrine, the anesthesia reaching a level of D6 at 7:58 A.M. An extended left McBurney incision was made at 8:21 A.M. A tumor was found in the rectosigmoid without any signs of local or liver metastasis. At 8:37 A.M. during the abdominal exploration there was sudden cessation of heart action and respiration. While atropine sulfate, 1/75 gr. was given and a blood transfusion started, an immediate incision was made in the left fifth interspace, the heart was exposed and found at a standstill and flabby, and cardiac massage was instituted, all within four minutes. In less than one minute feeble heart beats returned. Massage was continued until 8:50 A.M. when the blood pressure rose to 170/100 and the pulse was 140. Spontaneous respirations did not appear until 9:22 A.M. During this time artificial respiration was maintained. The abdominal incision was closed in layers. When the patient's condition was reported as good, the chest incision was closed leaving a Pezzer catheter. The patient was returned to his room with a Levin tube in his stomach, an endotracheal tube and a subaqueous chest drain. He was placed in an oxygen tent with intravenous glucose in water and glucose in saline running. His blood pressure was 135/70 but he was unconscious. He was having twitchings and convulsive movements at frequent intervals. The following day the blood pressure, pulse and urinary outflow were maintained. He was still unconscious and suction was maintained through the endotracheal tube. Blood pressure dropped to 86/50. The following day the blood pressure fluctuated between 110/58 and 164/70. Convulsive seizures continued and respirations were labored. The patient became cyanotic and died at 5:40 P.M.

ETIOLOGY

The anesthesiologist is usually the first to become aware of sudden cardiac arrest and it is on him that the burden of responsibility rests in a great majority of cases to notify the surgeon when the pulse and blood pressure waver and disappear. A constantly alert watch of the patient must be maintained for this condition by both the anesthetist and the surgeon since cardiac arrest may occur at any time during the anesthesia and at any stage of the operative procedure. The type of operation performed is of no aid in anticipating or preventing sudden cardiac arrest. It may also occur with any anesthetic agent or combination of agents which may cause serious depression and anoxia. If the anesthetist even suspects that there has been a cardiac arrest, the surgeon must be asked to check arterial pulsations.

The primary cause of failure in cardiac resuscitation is delay in diagnosis. Under other circumstances, however, when no peripheral pulse is palpable and blood pressure cannot be obtained by auscultation, three possibilities must be considered: (1) The heart has stopped beating entirely, (2) the ventricles are fibrillating or (3) cardiac contractions are so feeble that insufficient blood is ejected to raise arterial pres-

sure to the level at which a peripheral pulse can be felt. The only certain method of ascertaining whether the heart is still beating is to palpate or visualize the heart or large arteries directly. When the heart stops early in the operation and in light anesthesia, the diagnosis is fairly certain to be ventricular fibrillation. Other important causes of cardiac arrest under anesthesia are dilation and failure from toxic overdosage of the anesthetic in improperly administered anesthesia and coronary ischemia due to severe shock, the use of some common preanesthetic drugs and oxygen insufficiency. The noxious agent in most instances causes depression of the vasomotor center and consequently relaxation of the blood vessels before it affects the heart directly to the extent of causing cessation of its beat. In most of these conditions anoxia seems to be a common denominator.

The ability of chloroform, cyclopropane and ethyl chloride to sensitize the heart to the action of epinephrine is well known.[1] Hypoxia and excitement sensitize the heart and cause an increased content of epinephrine in the circulating blood. Hypoxia may sensitize the carotid sinus with a resultant reaction to stimulation of the carotid sinus, producing inhibition of cardiac activity. There may be sensitivity to a drug as when sudden cardiac arrest occurs under spinal anesthesia alone.

Adams and Hand[5] presented the various inhibitory effects on the heart of the vagus nerve in cardiac arrest. These effects are inhibited through the liberation of acetyl choline at the nerve ending. Atropine neutralizes acetyl choline. In cyclopropane anesthesia the use of epinephrine is contraindicated because of its tendency to produce ventricular fibrillation; when they are used in combination, procaine is given to diminish the sensitizing ability of epinephrine.

Negovski's experimental and clinical observations on revival[6] demonstrated that the sequence in which different functions of the central nervous system return is determined by the phylogenetic development of corresponding parts of the brain, i.e., the older areas were restored sooner. For the same reason, the heart revives before spontaneous respiration is restored.

Fauteux[8] and Bancroft and Dixon showed that barium chloride combined with epinephrine can help to restore cardiac tone and the force of the heart beat but in large doses may cause death in systole. Wertheimer and Boulet state that when used in appropriate dosage barium chloride can help to prevent ventricular fibrillation.

PROBLEMS IN TREATMENT

On one point in the treatment there is universal agreement, and that is the immediate institution of cardiac massage. On others, such as the portal of access to the heart and the rate of cardiac massage, there seems to be some difference of opinion.

Patients who become inanimate while under anesthesia fall into two categories,[10] namely, those with blue asphyxia (primarily respiratory) and those with white asphyxia (primarily cardiac).

Lahey and Ruzicka[1] quote Weinberger, Gibbon and Gibbon who demonstrated experimentally that treatment must begin within three and one-half minutes of cessation of circulation of blood. These workers showed that interruption of circulation to the brain for three and one-half minutes or longer resulted in permanent changes in psychic behavior. Interruption for eight minutes and forty-five seconds was incompatible with life for more than a few hours. This work is well borne out by the clinical experiences of many surgeons. Some plan of action can be posted in every operating room. It consists of (1) artificial respiration with 100 per cent oxygen, (2) immediate cardiac massage by the surgeon, (3) drug therapy consisting of the use of procaine and epinephrine and (4) general methods of treatment including the administration of intravenous fluids and the Trendelenburg position. The surgeon may perform a cardiac puncture, aspirate blood, and inject procaine and epinephrine before beginning the steps of cardiac massage. This step has value because some hearts showing clinical signs of cardiac arrest are not actually arrested. Artificial respiration may need to be continued from a few minutes to several hours after the reappearance of cardiac activity because cardiac activity does not always signal immediate return of respiratory activity. The approach to the heart depends on the operative procedure in which the arrest occurs but resolves itself into three routes, namely, transperitoneal subdiaphragmatic, transperitoneal transdiaphragmatic and

transthoracic. The rate of cardiac massage has been quoted at various figures. Nicholson recommends eighty compressions per minute. Gunn stated that compression should be gradual and relaxation abrupt with rate of compression at most only half the normal rate, i.e., about forty per minute. The massage must be interrupted at regular short intervals for a few seconds in order to allow spontaneous beats to develop. The lower than normal rate of compression was recommended in order to allow the ventricles to fill. In the excitement of the moment mechanical stimulation of the heart can be overdone and may cause the heart to go into ventricular fibrillation. One should frequently stop and watch for the first feeble heart beats. If these do not improve, help must be supplied at intervals; and it is here that epinephrine may frequently be of great aid. Epinephrine has been a time-honored favorite in any circulatory emergency. Its indiscriminate use with its ability to produce ventricular fibrillation is, however, always unwise.

Beecher and Linton[11] state that in the use of epinephrine in cardiac resuscitation evidence is at hand to show that the effective stimulus is not always the needle prick of the heart wall but that the epinephrine itself is important. Twice, after periods of cardiac standstill of thirty and twelve minutes, respectively, epinephrine produced resuscitation of the heart although needle pricks had failed to do so. When epinephrine is employed in cardiac resuscitation, 1.0 cc. doses seem to be dangerously large, with the hazard of production of ventricular fibrillation. In adults who have impaired hearts, and any heart in standstill is at least acutely impaired, it is doubtful if more than 0.2 to 0.3 cc. of 1:1000 solution of epinephrine should be used, and this should be diluted ten times before injection into the right auricle. This may be introduced by way of the right jugular vein. There is an analogy between cardiac massage and artificial respiration.[4] Artificial respiration helps to relieve anoxemia and to eliminate any volatile anesthetic agent, both of which factors contribute to the depression or paralysis of the vasomotor center.

Beck, Pritchard and Feil[12] report that ventricular fibrillation occurs as the terminal arrhythmia in approximately 50 per cent of patients. If ventricular fibrillation develops in hearts that are relatively normal, especially during operations, defibrillation may be life-saving. During the period before regular rhythm is restored the heart must be exposed and rhythmically massaged in the interval. This method of cardiac resuscitation has been developed in the laboratory by Hooker, Wiggers and Beck, and applied to patients by the latter. The method consists of the injection of 5.0 cc. of 2 per cent procaine hydrochloride into the right side of the heart followed by a brief period of cardiac massage to distribute the drug throughout the myocardial bed. The heart is then placed between two electrodes and a series of shocks is given to accomplish defibrillation. If the treatment is successful, the ventricles cease fibrillating and remain in standstill momentarily before a rhythm is established. Massage is again continued until the vigor of the heart beat is sufficient to empty the cardiac cavities of blood. Although the central nervous system and heart are spared any detectable damage, the kidneys receive a fairly severe temporary ischemic injury during the period of low blood pressure. Presumably this is the lower nephron type of renal lesion following shock about which much has been written in recent years. Therefore, all necessary measures should be undertaken in the immediate post-fibrillation period to sustain an adequate level of blood pressure and an optimum amount of fluid for renal function.

In the heart difficult to revive from ventricular fibrillation the following considerations are important according to Mautz:[13] Adequate cardiac message and artificial pulmonary ventilation must be instituted. If countershock is unsuccessful, intravenous procaine will produce a coarser type of fibrillation which can more readily be restored to a coordinated beat with an electric shock. In extreme dilatation which may follow a toxic dose of procaine dilute solutions of calcium chloride and adrenalin in small doses are antagonistic and aid in producing the necessary condition for restoration of a coordinated beat. When a feeble beat has been restored, gentle massage and, if this is ineffective, cautious administration of calcium chloride and adrenalin aid in restoring a vigorous heart beat. When procaine has been given prior to electric shock, there is little tendency to return to fibrillation unless excess calcium chloride is introduced. The heart must be carefully observed for a period of about twenty minutes for acute dilatation during the recovery phase.

Fauteux[8] believes that in the near future the

electrocardiograph will have a definite place in the operating room. When the patient is placed on the operating table, the electrodes should be adjusted immediately and the patient cable connected to the apparatus. A defibrillator is essential to resuscitate the heart from ventricular fibrillation. It is a life-saving device that should be in every operating room. It is believed that surgeons should be trained in cardiac resuscitation technics and should not wait for emergencies in the operating room to gain experience.

Professor L. Binet, Dean of the Paris Faculty of Medicine, and M. Strumza[14] have been successful in reviving animals after cessation of the respiratory action and of the beating of the heart by transfusing oxygenated blood through the carotid artery. The use of intravenous procaine as an adjuvant to other forms of anesthesia has been found of value in combating this problem.[18–20]

It is interesting to note the experimental work of Callaghan and Bigelow[21] whereby they were able to create regular heart beats in dogs after cardiac arrest by electrical impulses to the region of the sino-auricular node both at low and at normal body temperature, and also, in like manner, to increase or decrease the rate of a normally beating heart.

PROGNOSIS AND RESULTS

Barber and Madden collected 143 cases.[1] Forty-eight of these patients or 33 per cent were treated, with complete success. Bailey had a personal experience with forty cases of cardiac arrest. He was able to revive thirteen patients, of whom four survived. The Lahey Clinic had fifteen cases of cardiac arrest; cardiac action was restored in every case but in only five cases or 46 per cent was there recovery with normal mentality.

The heart is an amazingly resistant organ possessing rhythmicity and contractility which are difficult to destroy.[2] Whether the heart can be made to beat again regularly and whether this activity can be maintained depends upon the age of the patient, the cardiac status prior to the catastrophe and the cause of the cardiac arrest. Young healthy hearts may be restored to normalcy with relative ease, but a myocardium damaged by toxemia, arteriosclerosis, hypertension, coronary insufficiency or narcosis is much less likely to recover. When the heart returns to a regular rhythm and blood pressure is maintained, spontaneous respiratory activity can be expected to reappear within five to thirty minutes. This indicates that medullary cells are the most resistant in the central nervous system, a fact clearly established by many investigators. This also illustrates the fact that in the medulla itself the vasomotor center is more resistant than the respiratory center. Once vital functions have been restored, two possibilities exist. First, the patient may steadily improve until consciousness is regained and a partial or complete recovery is made. Unless the period of circulatory cessation has not exceeded two to three minutes, the postoperative course is stormy. Second, consciousness is never regained and death may be delayed for weeks.

PLAN OF TREATMENT

Obviously the best management of this problem is its prevention.[5] This necessitates an attempt to avoid onset of the inhibitory action of the vagus on the heart. Basically, anoxia should be avoided. This is accomplished first by prevention of increased vagal irritability resulting from suboxygenation or depressing effects of narcosis or anesthesia and second by the prevention of afferent reflexes, or vagovagal reflexes, which provide the inhibitory efferent effect. The latter is accomplished by avoiding or blocking whenever possible stimuli affecting the afferent pathways of the vagus nerve. Necessary procedures, such as aspiration of the trachea, hilar manipulations or any type of mechanical irritation in the nasopharynx, trachea, bronchi or esophagus which may produce afferent vagal stimulation, should not be carried out without adequate block of these pathways.[17] Local infiltration of the hilar plexes or topical application of an anesthetic to the tracheobronchial tree should afford some protection. In addition, the efferent effects of the vagus nerve are blocked directly at the myoneural junction by an adequate dose of atropine.

The most practical procedure to follow in the handling of these emergencies in the operating room is that recommended by the Lahey Clinic.[15] The essentials of this routine are as follows: (1) Present in the operating room should be a cardiac emergency kit consisting of a small tray containing two sterile 5 cc.

syringes, two 4 inch gauge "heart" needles, two 1½ inch gauge needles for aspirating solutions from ampules, two 5 cc. ampules of 1 per cent procaine, two 1 cc. ampules of 1:1000 epinephrine and two sterile files for opening glass ampule. It is to be noted that this kit contains two of everything to allow for breakage or contamination. The anesthetist may, as soon as he finds an absence of pulse and blood pressure and has notified the surgeon, inject intravenously an already prepared 10 cc. mixture of 9.5 cc. of 1.0 per cent procaine and 0.5 cc. of 1:1000 epinephrine. (2) As soon as the diagnosis of asystole is made, this emergency kit is immediately passed to the scrub nurse who draws up 4.75 cc. of the 1 per cent procaine plus 0.25 cc. of 1:1000 epinephrine into one of the syringes. If within thirty to sixty seconds after the anesthetist has injected 10 cc. of a similar mixture the heart has not resumed its beat, the scrub nurse attaches the cardiac needle to the syringe and hands it to the surgeon who introduces it into one of the chambers of the heart, usually the right ventricle. (3) During this time the anesthesiologist has started artificial respiration with 100 per cent oxygen and has seen to it that the patient's head is lowered; an intravenous drip of fluid is started if one is not already going. (4) While the surgeon is making the cardiac puncture, the nurse withdraws a second procaine and epinephrine mixture to be passed to the surgeon for injection through the original needle if there is no evidence of spontaneous heart beat at the end of thirty seconds following the first injection. (5) The surgical assistant should be preparing the left chest area for thoracotomy while the surgeon is making the cardiac injection unless either the chest or the abdominal cavity is already open. Unless there is positive evidence of spontaneous heart beats within thirty seconds after the first injection of procaine and epinephrine, cardiac massage must be instituted immediately. Gentle massage should be instituted at a rate of perhaps twenty to thirty times per minute until effective spontaneous heart beats are established.

A sensitive carotid sinus may produce asystole during operation, rarely longer than thirty seconds to one minute before spontaneous heart action is resumed.[15]

If ventricular fibrillation develops, measures to combat this serious complication in ways already discussed must be held ready.

CONCLUSIONS

1. A review of the literature is presented on cardiac arrest including the concepts as to etiology, physiology and treatment.

2. Six case reports are presented; of these five patients died and one lived. An analysis of these cases is presented.

3. The prophylaxis and treatment of these cases are stressed as they occur in the operating room.

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Guerrero reviewed 640 cases of uterine myoma in which treatment varied between hormonal therapy, x-ray therapy or surgery. Over 170 patients had no symptoms so they were simply observed for five years; no therapy at all was attempted. Almost 300 patients were operated upon but whenever possible simple myomectomy was performed and menstrual function was conserved. Total hysterectomy was necessary in almost fifty cases but the authors believe this operation should be performed only on patients over forty years of age with negative evidences of uterine cancer yet who persistently have frequent and copious vaginal bleedings. (It seems to me that if a badly diseased cervix is also present in conjunction with fibroids causing bleeding, this also is a positive indication that total hysterectomy—rather than a simple supravaginal one or simple myomectomy—is necessary.) (*Richard A. Leonardo, M.D.*)

CHANGES IN THE VERTEBRA CAUSED BY RUPTURED INTERVERTEBRAL DISCS

OBSERVATIONS ON THEIR FORMATION AND TREATMENT

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A SCIENTIFIC exhibit was presented at a recent convention of the American Medical Association by the writer, demonstrating the surgical technic of an original operation for the treatment of ruptured intervertebral discs.[1] This operation consisted of fusion of the bodies of the vertebrae. The intervertebral disc is completely removed through a partial bilateral laminectomy and replaced by full thickness bone grafts obtained from the crest of the ilium. Statistics on the results of this procedure performed on 262 patients since 1943 were presented. In preparation for this exhibit 150 of these patients were called into the office for physical examination and questioning. X-rays of their spines in various positions were obtained. A review of these x-rays, some of them eight-year follow-ups, disclosed many interesting changes in the vertebrae. These changes were pointed out to many leading orthopedic and neurosurgeons at the convention. Among the comments frequently made by them were: "I've never seen that before" or "I'm sure that is not common knowledge" or "I know of few articles in the literature where these changes in the vertebrae due to a ruptured disc, are completely described." It was remarks such as these which prompted the preparation of this article.

The local alterations in the bony structures of the vertebrae associated with a ruptured intervertebral disc are readily recognized by roentgenologists. They may be listed as follows: (1) narrowing or reduction in the width of the normal intervertebral space; (2) narrowing or decrease in size of the intervertebral foramen; (3) changes in the articular facets; (4) sclerosis of the subarticular regions of the vertebral bodies; (5) "arthritic" spur formation, general or local and (6) malalignment of the vertebrae. These findings are fairly well known and frequently encountered. However, the exact etiology of each of these changes, how they develop as a result of injury to the intervertebral disc and their relations to each other is not generally understood. The experience of the writer in treating ruptured discs by the vertebral body fusion method during the past eight years has presented an opportunity for a more careful and thorough study of these etiologic factors. The findings on our follow-up x-rays have given us the answer to many heretofore unanswered questions.

NARROWING OF INTERVERTEBRAL SPACE

In order to understand the cause of this condition one must recall the anatomy and physiology of the intervertebral disc itself.[2] The disc is composed of three separate structures: the nucleus pulposus, the annulus fibrosus and the cartilagenous plates. Each of these is composed of a distinctly different type of tissue. The cartilagenous plate is hard hyaline cartilage and on one side is firmly adherent to and covers the articular surface of the vertebral body; on the other surface the fibers of the annulus fibrosus are attached. The annulus fibrosus, as the name implies, is composed of tough fiber of elastic connective tissue arranged in an annular or circular fashion around the central nucleus pulposus, much like the circular arrangement of the layers of an onion. The nucleus pulposus or core of the disc is a semi-gelatinous, liquid-like substance in the center of the vertical diameter of the disc and located at the junction of the middle and posterior third of the intervertebral space. The nucleus pulposus is a remnant of the embryonic notochord. A vertical line drawn through the center of the nucleus will pass through the weight-bearing axis of the spine.[2]

The primary function of the intervertebral disc is to keep the adjacent vertebral bodies apart.[3] The nucleus pulposus being composed of a liquid (and therefore non-compressible) is held in its spherical or oval shape by the tough

elastic annulus fibrosus. It acts as a non-compressible strut to hold and keep the vertebral bodies separated. The amount of positive pressure in the intact disc and the amount of vertical compression necessary to rupture the disc is surprising. As a result of trauma the disc may be ruptured or torn. The tear takes place in fibers of the annulus, most often in the posterior half of the disc. Since injuries usually occur with the spine in flexion, the posterior fibers of the annulus are put on a stretch and are therefore more susceptible to being torn. As soon as the annulus is ruptured, the liquid substance of the nucleus pulposus loses its spherical shape, the liquid diffuses through the torn fibers of the annulus and the non-compressible support between the vertebral bodies is lost.

Once the intervertebral disc is ruptured and the support of the nucleus pulposus is no longer present, the patient has, and will always have, a pathologic vertebral joint whether it is symptomatic or asymptomatic. Nature cannot reconstruct a normal functional intervertebral disc once it has been ruptured. Clinicians and surgeons have entertained the false belief, and passed this on to their patient, that just because the ruptured disc is asymptomatic the disc has healed. It is impossible for a ruptured disc to heal. Even if healing did occur it would do so by scar or connective tissue replacement of the nucleus which would be compressible. The compressibility of a ruptured disc is demonstrated by the fact that in every case, if the patient is followed up over a long enough period of time, the intervertebral space becomes progressively narrowed. (Compare Fig. 1A and Fig. 1C.)

The length of time it takes for narrowing of the intervertebral space to become roentgenologically evident depends on several factors. When the nucleus is ruptured, being a liquid, a good portion of it is probably absorbed early. The annulus fibrosis alone is left to support the interspace. Its substance, being compressible, is flattened out by the weight of the body and movements of the spine grind its surface together. Fragments of the annulus, large and small, may break off from their attachments to the cartilage plate and move about within the interspace. They may herniate in any direction and become trapped or fixed. Posterior herniations are most frequently seen, due to frequent flexion of the spine; but anterior and lateral herniations have been described[4,5] as well as herniations into the overlying bone.[6] These loose fragments of torn disc moving about within the interspace or protruding outside the interspace (into the spinal canal) are often responsible for the symptoms of low back pain and sciatica.

The patient may have no loose disc fragments but only ragged, frayed edges of the annulus rubbing and grinding together. These are gradually pounded down and disintergration, degeneration and absorption take place. Due to the avascular nature of this tissue and its very low metabolism, these pathologic processes may advance at an exceedingly slow rate. Narrowing of the intervertebral space may take years to develop. But if the patient who has had a known ruptured disc is followed for a long period of time, this finding will always appear on the x-ray. Rapid degeneration of the disc from infection has been shown to result in narrowing of the interspace in a very short period of time.[7]

One may theorize as to the physical factors which may be responsible for the rate at which the narrowing of the interspace progresses: (1) The patient may lose a large fragment of the annulus fibrosus by herniation into the spinal canal and have it removed surgically. The amount of material that nature must remove by absorption is thus reduced. (2) The nature of the patient's physical activities may be a factor. Men doing heavy labor with considerable insult to the lower lumbar spine from bending and lifting may pound down a disc and a narrow interspace may develop within a few months. In women, and in men leading a sedentary life, this may take years. (3) The stature of the individual is certainly a factor. In a 200-pound man the last disc of the vertebral column must support nearly 120 pounds of weight in the upright position. In a 90-pound woman, weight bearing would be of less importance. (4) The unequal stresses of weight bearing may compress and degenerate one part of the disc more rapidly than another. This is seen in scoliosis of the spine. The intervertebral space becomes narrowed and the vertebra may eventually fuse, on the concave side of the scoliosis only. (5) Lastly, the metabolism of the individual and the blood supply to the disc may influence the rate of degeneration and absorption of the ruptured disc. This may vary from patient to patient, particularly regarding ages.

1A 1B

1C 1D

FIG. 1. A and B, preoperative x-rays (1944). Large unilateral ruptured disc removed; no spinal fusion. C and D, postoperative x-rays (1951). All vertebral changes secondary to ruptured disc are seen; note unilateral narrowing of interspace, local subarticular sclerosis and unilateral spur formation. (Compare with preoperative x-rays.)

DECREASE IN SIZE OF INTERVERTEBRAL FORAMEN

This finding, excellently presented in a recent report by Hadley,[8] is a constant occurrence with ruptured discs. The foramen through which the spinal nerves leave the vertebral canal is formed by the body of the vertebra and the intervertebral disc anteriorly, and the articular facet and ligamentum flavum posteriorly. Pathologic changes in any of these four anatomic structures can encroach upon the foramen. A narrowing of the opening and pressure on the nerve root results.

The most common cause of a narrowed foramen is herniation of a portion of the ruptured disc into the spinal canal. These posterolateral herniations of loose, torn fragments of the annulus, or a bulging of the nucleus pulposus through a rupture and thinned annulus, compress the nerve root against the overlying bone of the lamina. Sciatic pain results.

The second cause of foramen narrowing is an encroachment by a slipping of the articular facet. This results from loss of the intervertebral support (the nucleus) as described previously, with collapse and narrowing of the intervertebral space. The over-riding of the facet with weight bearing can be easily seen and measured in the oblique view of the x-ray.[8] (Fig. 2A.)

The changes which occur in the body of the vertebra, to be described later, resulting in so-called "arthritic spur" formation is the third cause of foramen narrowing. These proliferations of bone about the articular surfaces of the vertebral body may develop along the posterior margin, protruding into the foramen and encroaching upon the nerve root. (Fig. 3.)

Hypertrophy of the ligamentum flavum, which was described in several early articles[9,10] as a cause of nerve root compression by foramen narrowing, is now questioned. It is theoretically possible that prolonged insult to this interlaminar and interarticular ligament following a back injury, whether the disc is ruptured or not, may conceivably result in thickening sufficient to encroach upon the intervertebral foramen. These structures are extensively explored by the writer in performing his disc operation. Examination in over 450 patients who underwent disc operations has failed to convince the writer that hypertrophy of the ligamentum flavum as a definite pathologic entity does exist.

CHANGES IN THE APOPHYSEAL JOINTS

The changes which occur in the apophyseal joint as a result of loss of the intervertebral (disc) support, consist of slipping, degeneration of the cartilage, sclerosis of the bone and secondary bony proliferations or lipping. The slipping of the facet with weight bearing results in narrowing of the intervertebral foramen as described previously, with resultant pain. Tension or traction on the fibrous capsule of the facet caused by slipping, may also account for some of the patient's pain. Electrical stimulation of the joint capsule, at operation using local anesthesia, has shown this structure to be most sensitive and painful. The false motion setup in the apophyseal joint as a result of loss of the supporting function of the disc brings about changes seen in all weight-bearing joints, according to Wolf's law. With injury to the joint surface followed by excessive movement, an increase density develops in the underlying bone, and the edges of the bony surfaces subjected to most trauma become worn down. An excessive proliferation of bone in response to the irritation develops. The thickening and lipping of the edges of the facets are readily made out on the oblique x-ray.[8]

SUBARTICULAR SCLEROSIS OF VERTEBRAL BODIES

Sclerosis of the vertebral bodies is seen in cases of ruptured intervertebral disc of long standing. In the x-ray one sees an increased density of the bone extending away from the articular margin (disc surface) into the vertebral body varying distances. It is found on either side of a ruptured disc and is a constant finding when the intervertebral space has become narrowed. We have not found these changes in our x-rays of ruptured discs in which the interspace is still approximately normal in width. It has been a constant finding, however, that the narrower the interspace the more dense and wider the layer of sclerotic bone in the adjacent vertebral bodies. This finding would give a clue as to the etiology of the condition. It would indicate that trauma and time or the two factors responsible for the desposition of calcium salts in the cancellous bone of the vertebral bodies. The sclerotic proliferations may be seen as a uniform, thin layer over the entire articular surface of the vertebral body or they may be concentrated in one location. When local areas (Fig. 4) of sclerosis develop, they are most often seen in the anterior

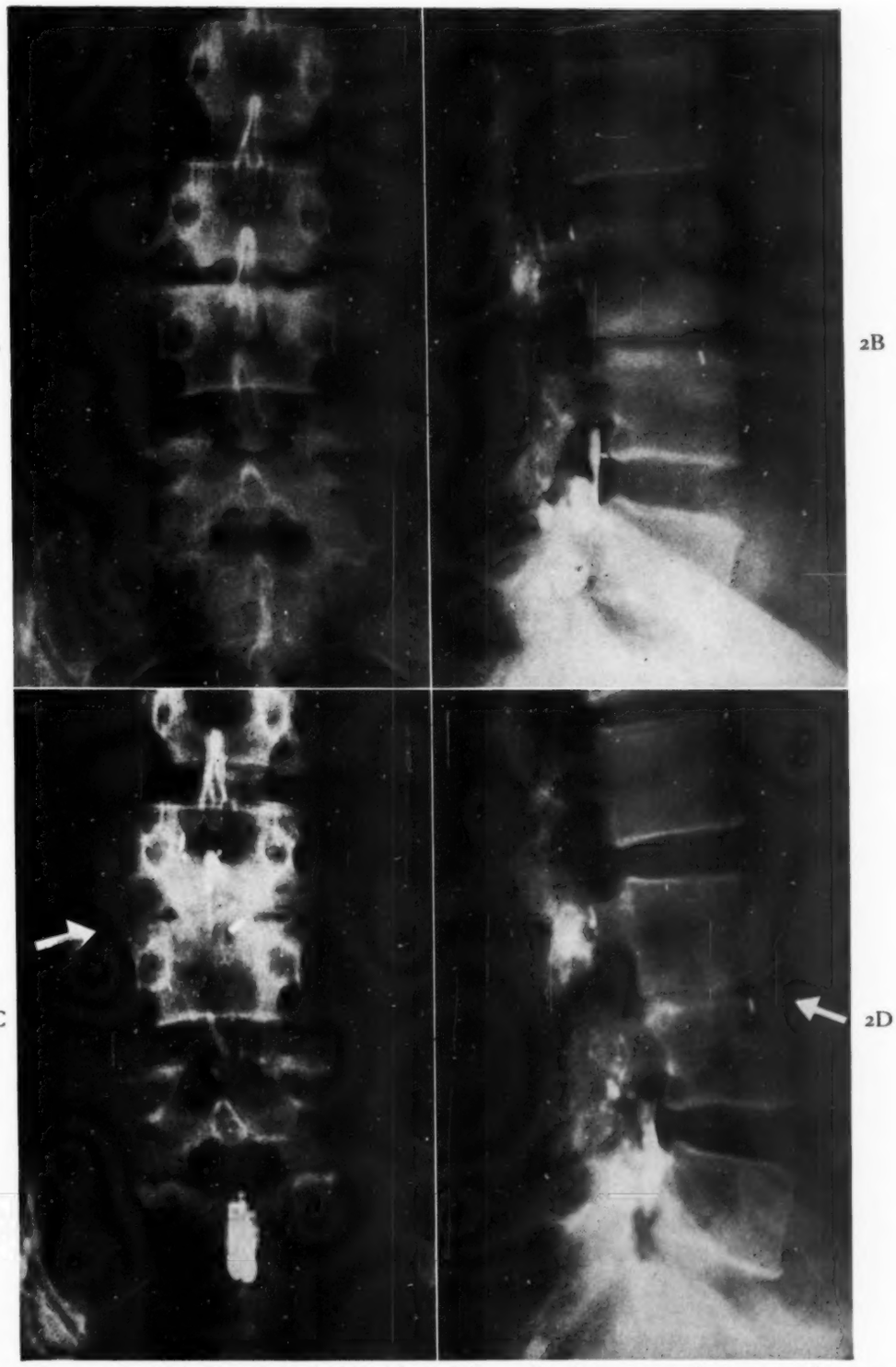


FIG. 2. A and B, anteroposterior (preoperative) and lateral (immediately postoperative) x-rays showing collapsed L3-4 disc. Increased density extends to center of vertebral bodies only; narrowed intervertebral foramen and spur formation are seen. C and D, same patient three years after removal of disc and vertebral body fusion. Note bodies of L3 and 4 have been converted into a single one by the intervertebral grafts; sclerosis and "arthritic" spurs have disappeared.

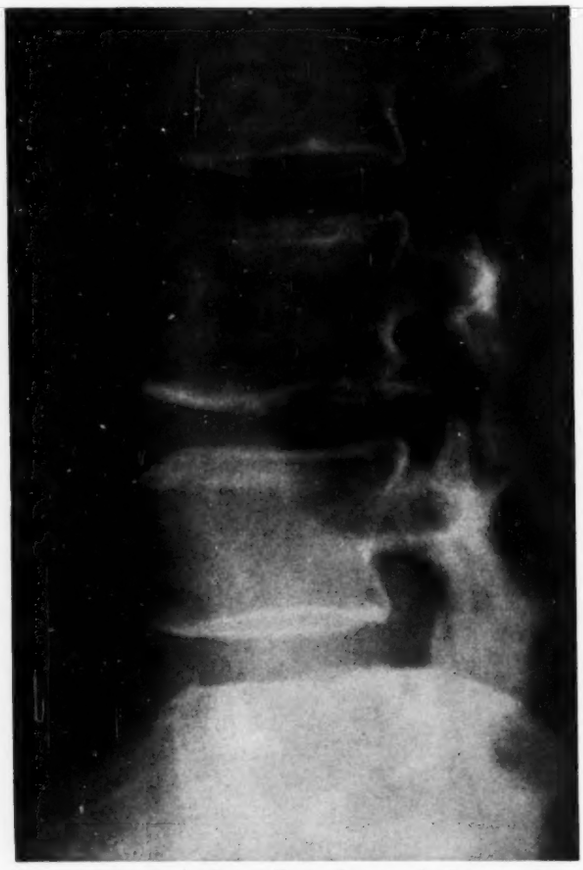


FIG. 3. Large, single, unilateral, marginal osteophyte projecting posteriorly, with marked encroachment upon the intervertebral foramen. Patient had intractable unilateral sciatica.

FIG. 4. Collapsed and degenerated disc L2-3 following back injury twelve years before. Vertebral changes similar to Figure 2B. Patient suffered with continuous back pain.

half or two thirds of the body. This area is subject to most trauma by flexion of the spine. In spines with severe scoliosis there is compression and degeneration of the intervertebral disc on the concave side of the curve. One sees in the resulting close aposition of the vertebral bodies, localized lateral sclerosis from unilateral degeneration of the disc. If the vertebra are in contact, they may even undergo spontaneous unilateral fusion.

When a single disc is ruptured and the discs above and below are normal, the sclerotic changes in the vertebral will not extend beyond the middle of the adjacent vertebral body, i.e., half way between the superior and inferior surfaces. (Fig. 4.) This may be explained on the basis of a separate venous drainage system of the superior and inferior halves of the vertebral bodies. However, a more logical explanation is that the chief weight-bearing stress of a single intervertebral disc is distributed to the inferior half of the vertebra above and the superior half of the vertebra below and not beyond these limits. (Fig. 2B.)

Trauma is unmistakably the cause of sclerosis. Following rupture of the disc and collapse of the interspace, the formation of this sclerotic bone will continue as long as the irritation of the vertebral bodies pounding on each other exists. The cause of local areas of subarticular sclerosis is thought to be due to an uneven distribution of the ruptured disc. This finding was seen in a patient in whom a large unilateral fragment of torn disc was removed from one side of the interspace and no spinal fusion done. Seven years later the intervertebral space on the side from which the disc had been removed was only half as wide as the other side and considerable localized subarticular sclerosis was seen confined to the adjacent vertebra on the narrow side only. (Fig. 1.)

That the irritation of one vertebra rubbing on the other is responsible for these sclerotic changes is also borne out by the fact that when this abnormal movement and irritation is

arrested by fusion of the vertebra, these sclerotic changes disappear. Within a period of a year or so after the intracorporal fusion has become solid, the dense layer of subarticular sclerosis in the vertebral bodies literally melts away. A uniform density throughout both the bodies and the intervertebral graft gradually occurs and the normal fine vertical lines of bony trabeculation become evident extending from one body of the vertebra to the other through the graft. (Compare Figs. 2B and 2D.)

MARGINAL OSTEOPHYTE OR "ARTHRITIC" SPUR FORMATION

There is probably no greater misnomer in medicine than the term, arthritis of the spine. Such a condition does exist in the form of: (1) acute arthritis marked by transient swelling of the apophyseal joint capsule and (2) rheumatoid or ankylosis spondylitis, an infection or metabolic disease of the vertebra which results in proliferation of bone and subsequent ankylosis of joints. These conditions are very rare. The writer has seen only one case of acute rheumatoid arthritis in fifteen years of examining painful backs. In every patient, however, in whom osteophyte formation is demonstrated on the bodies of the vertebra, roentgenologically, he is usually informed that he has osteoarthritis of the spine. It is not uncommon to see patients exploited with drug therapy, heat treatments and braces and given a bad prognosis because of this x-ray diagnosis. Not to mention the profound psychoneurosis which may be produced in some individual for fear they have the deforming ankylosing type of disease.

With our present knowledge of the pathologic physiology of the intervertebral disc and its effects on the vertebral bodies, it can now be positively stated that the proliferations of bone on the edges of the vertebral bodies which have been called "arthritic" spurs are in the majority of cases traumatic or degenerative disease and not due to infection. Trauma to the vertebra is secondary to a ruptured, degeneration, herniation and collapse of the intervertebral disc, which permits a narrowing of the interspace. In the trauma of everyday movements, of the spine, weight bearing, bending and twisting the edges of the vertebral bodies may come in contact with each other at certain points where the disc is thinned. Whereupon minute but recurrent fractures may occur in the vertebral edges,[20] and each fracture may heal with bony callous formation. As the injuries recur the callous multiplies, grows larger and a rim of osteophytes may finally develop about the entire periphery of the vertebral bodies above and below a thinned disc. With collapse of the interspace there is a bulging of the disc around its periphery in much the same fashion as an automobile sitting on a flat tire. The anterior ligaments grow loose, increasing the width of the triangular free space at this site. The proliferations of bone at the vertebral body edges take the contour of the bulging "flat tire" as they develop around it. In the x-ray they appear as "eagle beak" or "goose bill" spurs. Since narrowing of the intervertebral space is a prerequisite to their formation, osteophytes are only seen when the adjacent interspace is narrowed, giving evidence of a ruptured, degenerated disc. They have been properly designated as "discogenic" spurs.

Although the osteophytes as a rule develop around the entire periphery of the vertebral body, they may form locally, i.e., in only one area of the vertebra. The explanation for the formation of an isolated "eagle beak" spurs was not clear to the writer until a recent case was encountered in which a large ruptured disc was found to have herniated anteriorly rather than posteriorly.[4] The herniation forward in the intervertebral space, probably through a weakness of the anterior longitudinal ligament, was demonstrated preoperatively by the Lindbloom[12] technic of discography. The diodrast injected into the intervertebral disc at that level of the suspected rupture outlined a markedly convex bulging of the anterior longitudinal ligament. At surgery a large loose fragment of the annulous fibrosus was found jammed far forward in a deep pocket formed by the thin ligament anterior to the intervertebral space. The contour of the dye outlining the ligament around this herniated disc fragment had the exact shape and appearance of a local "goose bill" osteophyte formation seen so frequently. This suggested to the writer that the herniations of torn disc fragments through a thin area of anterior longitudinal ligament, either anterior or lateral, could be responsible for the focal irritation and give a pathologic etiology for local proliferations of bone which result in a single "goose bill" spur formation. (Fig. 5.)

FIG. 5. Large, single unilateral eagle beak "arthritic" spur, probably due to a localized anterior herniation of ruptured disc.

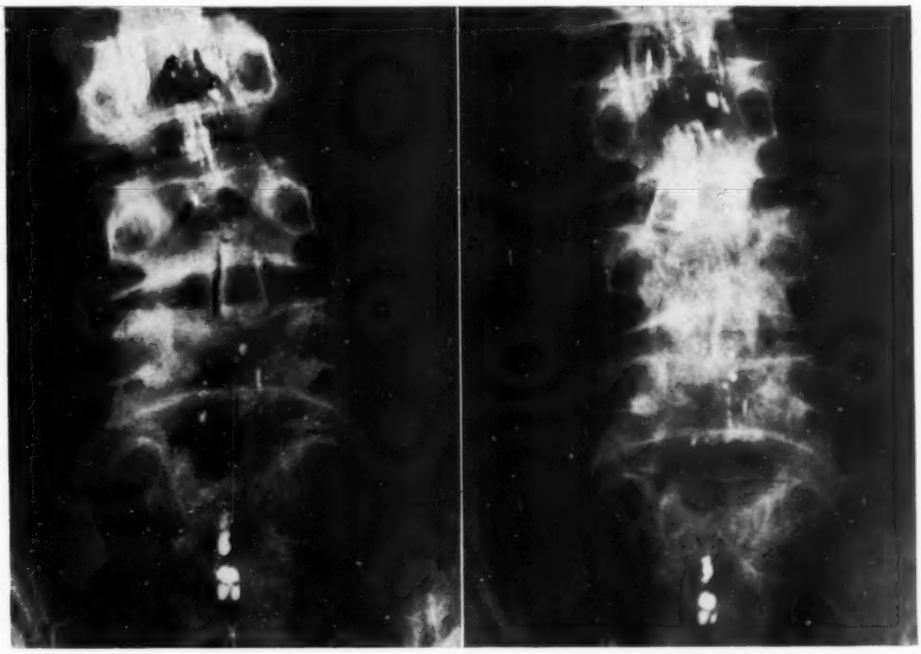
One of the most striking findings observed in the 150 x-rays of patients who had vertebral body fusions was a disappearance of these "goose bill" spurs after fusion. At least six cases were found in which moderate to marked osteophyte formation had been in evidence prior to the interbody fusion. It was most surprising to find the spurs either markedly reduced in size or completely gone within one to three years after the fusion of the adjacent vertebral bodies. Experienced orthopedic surgeons informed the writer that they have never observed this to occur in a spine. Although in other joints, according to Wolf's law, bony proliferation will cease when the irritating factor of false movement is arrested. The writer has had no experience with the posterior or Hibb's type of spinal fusion, but it would be interesting to observe if so-called "arthritic spurs" could be shown to melt away after posterior fusion. If they do not, it may indicate that although the bridge of bone along the spinous processes and laminae may appear solid and well fused, a considerable degree of movement may still exist between the vertebral bodies, particularly at the anterior border farthest from the fusion. This slight amount of irritation may be responsible for a continuation of the formation or the failure of absorption of the spurs. In the vertebral body fusions where all movement between the vertebrae is arrested, the formation of marginal osteophytes ceases and those which have developed disappear. (Compare Figs. 2B and 2D.)

MALALIGNMENT OF THE SPINE

The malalignment of the vertebrae so frequently encountered in patients with unilateral herniated discs has been referred to as "sciatic scoliosis." This finding has been universally accepted as being caused by unilateral protective muscle spasm, nature's method of opening up the intervertebral space on the side of the herniated disc by bending the spine in the opposite direction to relieve pressure on the nerve root. This belief is based on the physical finding of tightness of the sacrospinalis muscles on the concave side of the scoliosis. This finding may be the result of the scoliosis rather than the cause.[8]

In addition to a scoliosis of the lumbar spine a reversal of the normal lumbar lordotic curve is seen. Straightening of the lumbar spine is also attributed to voluntary or involuntary muscle contraction as a protection from pain.

It has been a source of considerable confusion to the writer, however, to find many cases of herniated intervertebral disc, with abnormal vertebral alignment who did not fulfill these classic criteria. For example, many patients have been seen whose scoliosis curved toward rather than away from the side of the lesion. We have also seen many patients in whom a marked scoliosis existed without back pain and without evidence of spasm in the lumbar muscles but only limitation of movement of the lumbosacral spine to the opposite side. The explanation of these findings has become evident to the writer in the past few years due to a complete exploration of the pathologic intervertebral space at surgery under direct vision. An instrument devised to spread the intervertebral space to more than twice its normal width,[13] has made this exploration possible. We have found in many cases large masses of the annulus fibrosus lying free in the interspace completely unattached to the cartilagenous

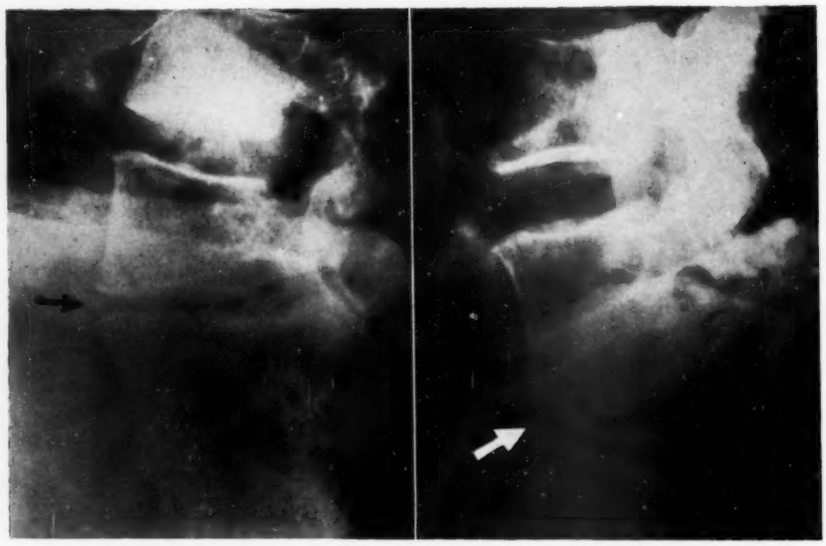


6A 6B

FIG. 6. A, anteroposterior x-ray after removal of ruptured disc (L4-5 and interbody "grafting"). Note wider "plug" on left with tilting of spine to right. B, same patient two years later; recurrent ruptured disc (L3-4) removed and grafted; note large plug on right; alignment of spine corrected.

plate. It is easy to see how these large fragments of disc material which have been ground from their cartilagenous attachments could move about in the interspace with movements of the spine. A wad of this loose disc material has been seen to lie entirely on one side of the intervertebral space, acting as a mechanical wedge to hold the vertebral bodies apart. The opposite side of the interspace would be correspondingly narrowed. A tilting of the vertebra and subsequent curvature of the spine would result from this wedging process without evidence on examination of local pain or muscle spasm. The absence of these clinical findings in such cases has resulted in diagnostic errors as to the etiology of the scoliosis. Tuberculosis of the spine, paravertebral abscess, poliomyelitis and other conditions having been seriously considered as the etiology. Such a case recently reported by Heyl[14] was observed in a child of thirteen years who had a ruptured intervertebral disc. In the surgical removal of a herniated intervertebral disc if a careful and thorough investigation of the interspace is not made, and if a complete removal of all disc material is not carried out, the surgeon may be confronted with the malalignment of the lumbar spine, either scoliosis or kyphosis, following surgery. This deforming abnormal posture is often permanent and quite distressing to the patient, particularly, females.

In a very small number of patients operated upon by the vertebral body fusion procedure, we have unintentionally produced the lumbar scoliosis by inserting a wider bony wedge between the vertebral bodies on one side of the spine as compared to a narrower one on the opposite side. (Fig. 6A.) One patient in particular in whom this condition resulted following surgery had another ruptured disc develop at the level above the fusion (L3-4) approximately eighteen months after the first operation. The occurrence of a second ruptured disc developing after a vertebral body fusion is exceedingly rare in the writer's experience (only two cases of 262). We have seriously considered the possibility of the abnormal mechanical alignment of the spine being responsible for the second disc ruptured. It is decidedly possible that the unequal stress applied to the adjacent disc by the abnormal alignment could be responsible for a tear with rupture of the disc above. It was interesting that the patient's sciatic pain with his first disc was in his right



7A 7B

FIG. 7. A, postoperative x-ray of degenerated disc L5-S1 with marked narrowing of intervertebral space. A "flat-tire" type of disc protrusion was found. The patient had severe low back pain but no sciatica. B, immediate x-ray after removal of disc and insertion of intervertebral grafts; note width of the intervertebral space and intervertebral foramen have been restored to normal. (This patient was out of bed and walking, without cast or brace, on the tenth postoperative day free of pain.)

leg and with the second, in the left. The posteriolateral herniation of the ruptured nucleus occurred on the left side at the site of the most stress resulting from the vertebral tilt. At the second operation a large plug was inserted into the intervertebral space on the opposite side, intentionally, to straighten out the weight-bearing axis of the spine. (Fig. 6B.)

SUMMARY, COMMENTS AND CONCLUSIONS

Six pathologic conditions which develop in the vertebra following rupture of the intervertebral disc have been described and mention has been made from time to time regarding treatment. As far as we have been able to determine no single treatment has ever been devised which will restore to normal each and every one of these pathologic states. The writer's operation of vertebral body fusion after removal of the intervertebral disc was originally designed in an attempt to treat all of these vertebral changes which result from a ruptured disc. In the first place, the width of the intervertebral space is preserved or, if narrowed, is restored to normal by the large heavy noncompressible full thickness grafts of iliac bone. (Fig. 7.) By increasing the width of the space between the two vertebrae the intervertebral foramen is enlarged and maintained, obviating the danger of nerve root compression from a narrowed foramen. The changes in the articular facets regress after these structures are fused. The subarticular sclerosis in the vertebral bodies and particularly the "arthritic" spurs and lipping on their edges melt away and disappear with the arrest of movement between them. Lastly, restoration of the normal curve and alignment of the vertebrae results from the removal of the pathologic processes which were responsible for it.

The posterior type of spinal fixation may arrest the progress of some of these pathologic conditions but cannot restore all of them to normal. It is for this reason that most surgeons who do posterior spinal fusions admit failures to relieve completely the patient's symptoms in 10 to 40 per cent of cases.[15–18]

One author[19] admitted failure to relieve back pain in 83 per cent of spinal fusion operation, the failure being due to pseudoarthrosis. A review of fusion operations performed at all levels of the spine showed the greatest number of failures to occur at the L4-5 interspace.

The over-all results in 262 patients upon whom the writer has performed the vertebral body fusion have shown a complete cure in 85 per cent of the patients, with restoration of the function of the spine as well as the patho-

logic changes to normal. It might be implied from these findings that the operation of vertebral body fusion after removal of the intervertebral disc may be the answer both anatomically and physiologically to the controversial subject of the treatment of the ruptured lumbar intervertebral disc.

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also believed that the vascular regression in the disc was a predisposing factor to fissure formation.

This brings up another consideration among the factors contributing to early degeneration. Böhmig[3] found that in childhood the disc is a vascular structure with vessels derived from the vasculature of the marrow of the adjacent vertebral bodies. Each cartilage plate has a central vessel as well. Obliteration of this disc vasculature is seen to begin at about the eighth month of life and to be completed at about the twentieth year. As previously stated, the perforations in the spongiosa correspond with the gaps in the cartilage. From this observation arises the belief that these gaps originally served as vascular channels and remain as sites of decreased resistance following obliteration of the disc vasculature. Furthermore, the comparatively early conversion of the disc from a tissue with its own blood supply to one which is dependent for nutrition upon diffusion from contiguous tissues predisposes to degeneration.

Another indication of the inadequacy of the cartilage plate as a barrier between nuclear material and the spongiosa of the vertebral body is its inability to withstand the pressure imposed against it by the natural turgor of the disc in the young. Beadle cites the example in which the spongiosa was carefully scraped away from the cartilage plate with prompt bulging and, in many instances, infraction of the plate due to the expansion of the adjacent nucleus pulposus as soon as sufficient spongiosa was removed.

There is unanimity of opinion of all authors[1–3,6,7,12,14,15] who have made anatomic studies that the crux of the degenerative process in the disc and its component structures is progressive desiccation and, with this loss of fluidity, a decrease in the resiliency of these structures. Thus loss of disc fluid into the spongiosa via these ubiquitous defects in the cartilage plate completes a vicious cycle whereby the initial degenerative processes act to propagate themselves.

Beadle's studies of the spines of adolescents and young adults showed in over 50 per cent of the cases not only the aforementioned cartilage plate defects which gave disc fluid access to the spongiosa, but also migration of actual nuclear material into the spongiosa. This is not consistent with the comparatively infrequent presence of Schmorl's nodes as seen on x-ray films. However, the studies of Junghanns[7] showed that in the living spine the great majority of these prolapses could not be seen by x-ray since sufficient reactive changes within the spongiosa had not occurred. Only in the occasional case in which a bone envelope forms about the extruded nuclear material is Schmorl's node detectable on x-ray. This loss of actual substance, with thinning of the disc, also contributes to the aforementioned vicious cycle.

Examination of postadolescent spines revealed accentuation of the degenerative process. Widespread fibrillar degeneration was noted, with concentric and radial fissures in the annulus in relation to the nucleus. In addition, that portion of the annulus dorsal to the nucleus was the site of frequent oblique fissures extending toward the vertebral canal and frequently reaching it.

Furthermore, evidence of hemorrhage was frequently seen, even in the instance of the smallest fissure. The source of the damage was thought to be trauma with extravasation of blood from the spongiosa via the defects in the cartilage plate into the disc substance itself. Frequently the hemorrhage was found to be extensive, particularly in the lumbar region, in discs manifesting only mild changes as well as in those with severe and extensive degeneration. Beadle states that "It is not uncommon to find the discs severely broken up by degeneration and clods of swollen disc substance stained at many points with fresh blood."[2] Thus we must add to the vicious cycle the frequent occurrence of hemorrhage secondary to degeneration caused by the routine functional trauma which is responsible for the degeneration.

Certainly these established anatomic findings give credence to the claim that the frequency and age incidence of low back pain is not disproportionate to the occurrence of intervertebral disc pathology. The next question to be settled is whether the anatomic findings are consistent with the almost invariable migration of the nucleus dorsally toward the spinal canal rather than ventrally. We are again beholden to Beadle[2] for the gross and microscopic data concerning these factors. His studies showed that the annulus is constructed much more loosely posteriorly than anteriorly, not only in regard to its own intrinsic fabric but also in regard to its attachments to contiguous bone and the posterior longitudinal ligament. Furthermore, the posterior portion of the annulus

is not sustained by the posterior longitudinal ligament as is the anterior portion by the anterior longitudinal ligament. The anterior longitudinal ligament is a powerful band with strong attachments along its entire course. In contrast, the posterior longitudinal ligament is weak and loose. It is comprised of a series of fan-like bands which spread out at the disc attachments but which are narrow opposite bone to which they have only scanty attachments.

Microscopic examination of these structures shows unmistakably that the fibers of the annulus are much coarser and stronger anteriorly than posteriorly, and that the complex formed by fusion of the annulus, longitudinal ligament and bone is conspicuously stouter and more powerful anteriorly than posteriorly.

CLINICAL CONSIDERATIONS

If the pathologic findings are as frequent and constant as claimed, a fairly constant clinical pattern should be derived therefrom. This pattern, within a certain range in intensity and variability, will be obtained with a constancy approaching monotony provided an adequate history is obtained and meticulous physical examination is performed. The clinical picture is predicated essentially on the following two insufficiently appreciated facts: (1) The intervertebral disc is a structure copiously supplied with sensory nerves and that therefore any internal derangement can be painful. (2) Subtle but definite neurologic signs and symptoms referable to involvement of sciatic nerve components can be present in the absence of history of sciatica.

Roofe[13] in 1940 demonstrated conclusively the presence of a copious sensory nerve supply in the annulus as well as in the posterior longitudinal ligament. These sensory fibers were shown to be derived from a recurrent branch arising from the dorsal root just lateral to the ganglion which re-entered the spinal canal via the intervertebral foramen and coursed distally to provide sensory innervation to the vertebral tissues two segments below the level of its origin.

Furthermore, the fact that usually the patients are completely or relatively symptom-free during the intervals between the episodes, despite incapacitating severity of the pain during the episodes, also indicates that the pain is on the basis of some suddenly induced and reversible internal derangement such as the dislodging of the nucleus from the normal position.

Keegan[8] clarifies the possibility of having signs and symptoms referable to sciatic components in the absence of sciatica. The critical feature is the caliber of the spinal canal at the level of the lumbosacral junction. Keegan's investigations revealed that the canal may be narrow so that the bulge of the disc is obliged to compress a nerve root, or may be spacious so that the bulge merely displaces the root; hence in the latter case the possibility of subtle neurologic signs from impingement rather than frank sciatica from compression.

A classical hypothetic case provides the following data:

An otherwise healthy male or female in his or her fourth decade is seen with the chief complaint of low back pain. The initial onset of pain came on abruptly several years previously immediately following some untoward motion involving the lower back. (This untoward motion may have entailed a forcible twisting, bending or lifting motion possibly but not necessarily including a certain element of mild trauma; or it may have consisted of merely straightening up from a bent position or getting out of a deep chair.) The pain was sudden, severe and disabling. (Usually it was totally disproportionate to whatever element of trauma was associated with the onset.) The pain was felt across the low back region but was seated about the lumbosacral joint without any predominance on either side. The patient was prevented by pain from resuming a normally erect posture and walked with forward inclination of the trunk. The patient accommodated to the disability as well as possible by limiting activity and even remaining in bed. The patient stated that it was difficult to remain comfortable in any one position for any length of time, even while recumbent. In some instances a physician was called, a diagnosis of "lumbago" or "low back strain" made and tape strapping applied, with some comfort derived from the latter. There was progressive spontaneous subsidence of the pain and disability in the ensuing days until the patient became completely symptom-free.

Thereafter, the patient stated, there were recurrent episodes similar to the first, coming on suddenly with some untoward motion and subsiding spontaneously within the ensuing

week or so. During the intervals between these episodes no low back symptoms were present except possibly for an occasional momentary twinge on lifting or twisting.

In the past eighteen months the patient had noted a progressive increase in the frequency, severity and duration of these episodes. During one of these episodes the patient noted some lateralization of the pain which now extended to the sacroiliac or gluteal region of that side.

Direct interrogation of the patient revealed further details: Coughing and sneezing accentuated the pain. No sciatica was noted at any time. (However, the patient may have had an occasional "numb" feeling on the side of the pain or the homolateral leg may have "fallen asleep" occasionally.) During the relatively asymptomatic periods between episodes the patient was aware of a feeling of "soreness and stiffness" in the low back region on awaking in the morning. This soreness did not, however, arouse him out of a sound sleep in the early morning hours. Upon arising it took the patient an hour or two to "limber up," with subsidence of the soreness and stiffness. (These are significant points in differential diagnosis since in Marie-Strümpell arthritis the patient is characteristically weakened by the pain in the early morning hours and obtains relief by stirring about for a few minutes. He then returns to bed and awakens at his usual time with the symptoms again present. Upon arising the pain and stiffness subside promptly in ten to twenty minutes. In the case of the degenerated intervertebral disc the patient sleeps the whole night through and requires an hour or two of morning activity for the limbering-up process.)

Physical examination revealed a well developed and nourished male (or female) not appearing acutely ill but moving guardedly. There was some flattening of the normal lumbar lordosis and moderate paravertebral muscle spasm. When asked to point out the seat of the pain with one finger the patient pointed to the lumbosacral joint (or to the sacroiliac or gluteal region of one side on which lateralization has occurred). Forward bending was moderately limited, with pain at the extreme of the motion. This was also true, but to a somewhat greater degree, of backward bending. However, backward-lateral bending to the side of the pain was most limited and painful, and accentuated the lateralization.

Deep palpation and shock percussion elicited maximum tenderness over the lumbosacral area.

Inspection and palpation revealed mild flattening of the contour and a sag of the buttock on the involved side. Hypotonia was detected on palpation. Hypotonia was also noted in the thigh and calf musculature on the involved side. (Painstaking examination will detect the difference in the mild case.) The mid-thigh circumference on the involved side was ¾ inch less than that on the opposite side. The mid-calf circumference on the involved side was ⅜ inch less. Straight leg-raising was mildly positive on the involved side.

Neurologic examination revealed no disparity in motor or sensory findings. There was slight diminution in response of the Achilles jerk on the involved side (in alacrity of response if not in excursion). (It should be noted that not infrequently a mild band of hypesthesia along the sensory distribution of an involved nerve root is noted or some mild motor disparity from a similar source. It should also be noted that a normal Achilles jerk does not vitiate the diagnosis since Keegan found that in about 50 per cent of cases the first sacral rather than the fifth lumbar root is compressed.)

Anteroposterior and lateral views of the lumbosacral joint revealed mild narrowing of the intervertebral space.

COMMENTS

These findings, with a certain permissible range of individual variation, occur with remarkable constancy if a complete history is obtained and a meticulous physical examination is done. It is admitted that any one or two of the previously noted details may exist alone and not necessarily have any clinical significance. However, in aggregate they comprise a well integrated syndrome.

A consideration of the dynamics of each symptom and sign is now in order:

Originally the midline low back pain was categorically attributed to distention of the posterior longitudinal ligament. However, the investigations of Roofe showed that the disc itself has an intrinsic sensory innervation to account for the pain. In fact, Roofe found a greater number of non-myelinated fibers in the disc substance than in the posterior longitudinal ligament. Thus any internal derangement of the disc can be painful irrespective of any involvement of the posterior longitudinal liga-

ment. This accounts for the characteristic abrupt onset of the pain with some untoward motion which happens to so affect the internal dynamics of the disc as to impel the nucleus pulposus posteriorly from its normal position.

Further evidence in this regard has been provided recently by Wiberg[16] who performed laminectomy under skin anesthesia. No pain could be elicited from the ligamentum flavum, even upon cutting this structure. Pressure on the posterior aspect of the vertebral bodies caused no pain except in those few instances in which the transmission of the pressure resulted in movement of the disc. On the other hand, pressure on the disc itself produced deep lumbosacral pain, even after anesthetic injection of the nerve root, indicating that the pain mechanism within the disc is independent of the corresponding nerve root.

The gradual subsidence of the pain is interpreted as being coincident with the gradual return of the nucleus pulposus to its normal position. In a consideration of this midline low back pain the incurrence of traumatic inflammation, with its subsequent subsidence, must also be acknowledged. The role of trauma is amply attested to by Beadle's frequent finding of fresh hemorrhage.

Furthermore, the fact that usually the patients are completely or relatively symptom-free during the intervals between the episodes, despite incapacitating severity of the pain during the episodes, also indicates that the pain is on the basis of some suddenly induced and reversible internal derangement such as the dislodging of the nucleus from its normal position.

Keegan explains the occurrence of the low back pain with lateralization without reference beyond the low back region. He found that there is a tendency for the nerve root, even in those cases in which the caliber of the spinal canal allows unrestricted displacement, to be compressed as it passes out of the spinal canal into the intervertebral canal by a special lateral portion of the ligamentum flavum, deeply situated and extending between the bases of the articular processes. Keegan calls this band the "interarticular ligament" and does not consider it a part of the true ligamentum flavum. It is against this band that the first sensory contact of the posterior primary division of the compressed nerve root is made. The sensory distribution of this nerve is to the gluteal area and hence the lateralization of the pain without true sciatica. This also explains the mechanism of the chief complaint in those numerous hypothetic and spurious syndromes of sacroiliac strain, the superior gluteal nerve syndrome (the superior gluteal nerve is entirely motor), sacrospinalis and gluteal myofascitis, the pyriformis syndrome and so forth.

The causes for some of the routine physical findings are obvious. The point tenderness over the spinous processes of contiguous vertebrae is derived from transmission of the pressure to the painfully deranged disc. The paravertebral muscle spasm provides an automatic splint. Bending in any direction is painful and limited because of the attendant motion in the involved disc. However, backward bending and especially backward-lateral bending to the side of the lesion are particularly painful or, during a mild or subsiding episode, may be painful when bending in other directions is painless and unlimited. Furthermore, it may induce or exaggerate lateralization of pain usually confined to the midline. The backward and lateral bending, individually or in combination, tends to approximate the vertebral bodies on that side, compressing the disc on the side of the nuclear displacement and thereby increasing the extrusive force exerted upon the already displaced nucleus. This obviously promotes further displacement of the nucleus, with increase in pain. This also explains the flattening of the normal lumbar lordosis which widens the intervertebral space posteriorly, thereby tending to alleviate the pressure impelling the nucleus posteriorly. These same dynamics account for the list to the side opposite to that of the pain. The list is an automatic protective mechanism which shifts the center of gravity of the body as far away as possible from the painful side of the disc, thereby decreasing the exertion of the force tending to increase nuclear extrusion derived from the superincumbent body weight.

The positive straight leg-raising test is a function of the tautening of the affected nerve root over the protrusion. Falconer[5] and his associates observed the effect of straight leg-raising upon the involved nerve root exposed surgically, and noted that the restriction under anesthesia was comparable to that noted prior to anesthesia, indicating that the pain is not due to muscle spasm but to actual compression and stretching of the extradural spinal roots.

The presence of neurologic signs is the result

of nerve root compression which, in general, is a reflection of the balance between the size of the protrusion, the mobility of the root and the caliber of the spinal canal. Certainly, the early episodes of low back pain in any given case need not entail protrusion to a degree sufficient to produce significant impingement against a nerve root. A spacious spinal canal may permit protrusion of considerable size to displace an unrestricted nerve root without any detectable neurologic signs. In fact, Dandy[4] removed discs from twenty patients with recurrent low back pain without sciatica and found in seven instances large protrusions actually compressing nerve roots but yet without producing sciatica.

Thus it is apparent that the mechanism capable of producing detectable neurologic signs can be, and usually is, present despite the absence of sciatica.

The x-ray finding of a narrowed intervertebral space is, of course, the result of the bulging disc increasing its horizontal dimension at the expense of the vertical. Furthermore, escape of nuclear fluid and material into the vertebral spongiosa also tends to decrease disc volume. On the other hand, the recent anatomic and radiographic studies on 100 autopsy specimens by Friberg and Hirsch[6] showed that marked degeneration in a disc may exist without roentgen evidence. Therefore, a comparatively normal intervertebral space does not rule out a degenerated disc as the source of low back pain.

DIFFERENTIAL DIAGNOSIS

Aside from intervertebral disc degeneration the common causes of low back pain that can be diagnosed routinely are spondylolysis, spondylolisthesis and Marie-Strümpell arthritis. This does not include common spinal conditions not classical for the lumbosacral region exclusively, i.e., spondylitis from the various chronic granulomas, senile and/or postmenopausal osteoporosis, degenerative joint disease (so-called hypertrophic arthritis) and so forth.

A discussion of the various points in the differential diagnosis of the abovementioned low back conditions will be published elsewhere. However, it is within the realm of this discussion to probe the validity of such diagnoses as sacroiliac sprain, lumbosacral sprain, postural sprain, the gluteal nerve syndrome, various types of fascitis or myofascitis, muscle decompensation, lumbosacral arthritis, sacroiliac arthritis, the facet syndrome, pyriformic syndrome and sciatic scoliosis. Most of these diagnoses are predicated on the fact that there is lateralization of the pain and that it is only logical to incriminate some structure or tissue lateral to the spinal column as the seat of the disorder. The baffled physician resorts to such dialectics only too frequently.

The sacroiliac joint comes in for its share of unjust accusation. Certain anatomic features of this joint make it probably the most stable in the body. The sacrum fits like a keystone into the triangular space between the ilia, with the superincumbent body weight tending to impact it snugly. Furthermore, the plane of the joint is not nearly as vertical as routinely considered. It is about 45 degrees, midway between vertical and horizontal, which also contributes to the forces impacting the sacrum against the ilia. Any shearing force is minimized thereby. Further stability is provided by the fact that the sacroiliac joint is a so-called congruous joint. Projections on one surface fit into corresponding depressions on the opposing surface, which tends to lock the joint. Finally, the joint is invested with powerful and broad ligamentous bands and sheets. The posterior interosseous ligament, the long and short posterior sacroiliac ligaments, the sacrotuberous and sacrospinous ligaments and the anterior sacroiliac ligament all provide unusual stability to the joint.

Thus a joint with so many powerful factors providing stability would require considerably more trauma than the aforementioned usual untoward motion either to alter the relationship of its surfaces or provide sustained and painful stress to its soft tissue investments. A consideration of fractures of the pelvis attests further to the stability of the sacroiliac joint. The sacroiliac joint is dislocated infrequently as compared with the occurrence of fracture through the wing of the ilium, and a sacroiliac dislocation almost invariably is accompanied by a fracture with appreciable displacement elsewhere in the bony ring of the pelvis.

The diagnosis of lumbosacral sprain is another much maligned entity. No doubt the lumbosacral ligaments can be sprained just as any ligament can be sprained. However, analysis of the routine case reveals that the precipitating motion usually does not entail sufficient trauma to sprain a stout ligament and that the acute symptoms arise from a straight-

ening-up movement that tends to slacken rather than tauten the lumbosacral ligaments. Further doubt is cast upon the validity of such a diagnosis in case of lateralization where bending to the side of the lesion increases the pain. Furthermore, pain on both forward and backward bending is also inconsistent with ligamentous sprain. For instance, in an inversion sprain of the ankle, inversion which tautens the injured structure is painful whereas eversion which slackens the injured structures relieves pain.

Postural strain is another ambiguous condition which may conceivably exist and also is frequently a diagnosis of convenience rather than of scrutiny and analysis. The previously cited anatomic reports have shown the widespread incidence of degeneration in the various tissues in the adult spine, and those people with what are considered abnormalities in posture are no exceptions. It is conceivable that the postural abnormality may contribute to the attrition levied against the disc, but the pathologic condition resides in the disc and the symptoms derived therefrom cannot be ascribed to such ambiguous conditions as "postural imbalance" or "muscle decompensation."

The so-called gluteal nerve syndrome is readily disposed of as a clinical entity. As stated previously, the gluteal nerve is completely motor in function and hence cannot transmit afferent sensory impulses.

Fascitis and myofascitis are two alleged conditions that fail to survive scientific scrutiny. Perusal of the literature failed to reveal any valid pathologic report indicating the existence of actual inflammatory changes in muscle and/or fascia as a cause of low back pain. The terms are evasions rather than diagnoses.

Two other garden-variety diagnoses are sacroiliac arthritis and lumbosacral arthritis. Sacroiliac arthritis occurs in the young adult as Marie-Strümpell arthritis, the diagnosis of which is usually established routinely on the characteristic history, laboratory data and x-ray criteria. In the older person degenerative joint disease (commonly and erroneously called osteoarthritis and hypertrophic arthritis) may involve the sacroiliac joints, as it may any joint in the body, and cause low back pain. However, it is not infrequent for a diagnosis of sacroiliac arthritis to be made in cases of low back pain in which the roentgenograms fail to reveal any abnormality of the joint, and in which the diagnosis is based on what is erroneously interpreted as an osteophytic spur off the inferior margin of the ilium immediately lateral to the lower pole of the sacroiliac joint. It is insufficiently appreciated that this is an apparent rather than a real protuberance, produced by an adjacent notch in the inferior iliac margin, marking the course of a blood vessel, rather than by any osteophytic overgrowth.

Similarly, degenerative joint disease may involve the lumbar spine and cause low back pain. However, each vertebral body shows comparable x-ray evidence of alteration. Therefore it is not reasonable to accept such a diagnosis in a case in which the x-ray shows localized lipping of the contiguous margins of the vertebral bodies without comparable changes in the remainder of the lumbar segment. Rather, it is reasonable to attribute this localized lipping on either side of an intervertebral space to some pathologic condition of the intervertebral tissues. Beadle's data corroborate this contention. He found that as degeneration in the disk advanced, the progressively deteriorating cartilage plate was fortified by the development of a layer of compact bone in the contiguous spongiosa. This osteogenic process extended beyond the original dimensions of the vertebral body, thereby producing a marginal rim of bony overgrowth seen in profile as a spur or osteophyte protruding from the superior and inferior surfaces, respectively, of the vertebral bodies flanking a degenerated disc.

The possible role of the articular facets of the lumbar spine has never been clarified. However, reports on many hundreds of spinal fusions performed for low back pain for one reason or another fail to mention any outstanding pathologic changes in the apophyseal joints.

Sciatic scoliosis still appears in the literature.[10] However, it is generally conceded to be merely a clinical finding occurring in the vast majority of cases as a part of the clinical picture of a ruptured intervertebral disc in which sciatica and a list of the trunk are present.

DIAGNOSTIC TEST

In most cases of degenerated intervertebral disc an adequate history and physical examination, possibly with some roentgenographic assistance, will establish the diagnosis. However, in some instances doubt will persist. This is particularly true in those early or heretofore mild cases in which the characteristic history

and findings have not as yet developed. In fact, the episode in question may be the initial occurrence of low back pain.

Difficulty in diagnosis also occurs in those cases in which the symptoms have been initiated by trauma of sufficient severity to conceivably cause painful injury to the tissues in the lumbosacral region as well as produce internal derangement within an intervertebral disc undergoing degeneration. This situation is frequently encountered in industrial accident cases which are routinely diagnosed as lumbosacral sprain. Hence it becomes expedient in these equivocal cases to have a test whereby it can be determined whether the intervertebral disc is the offending tissue. The fifth lumbar intervertebral disc was injected with novocain in six cases. This procedure was prompted by the recent report of Lindblom[11] on diagnostic discography in which a radiopaque medium was introduced directly into the substance of the disc. It occurred to the author that since it was shown that several cubic centimeters of fluid could be injected into a disc undergoing degeneration and since the disc substance has a sensory nerve supply, the injection of novocain into the disc would be a valid means of either incriminating or absolving the disc in any given case of undiagnosed low back pain.

The technic described by Lindblom was followed. A lumbar puncture via the fifth lumbar interspace was performed with a large bore needle. The needle was advanced ventrally until the posterior longitudinal ligament was contacted. The position of the needle was then checked by x-ray to determine whether it was properly directed toward the disc, and any necessary adjustments were made. A second needle, longer than the first and of sufficiently fine gauge to fit into the barrel of the first, was then inserted through the first needle and advanced through the posterior longitudinal ligament into the disc substance. Position was again checked by x-ray and, if satisfactory, 5 cc. of 1 per cent novocain were injected. In each one of the six instances the characteristic low back pain was either reproduced or accentuated initially, presumably by the distention of the disc. Effect of the novocain ensued in about one to four minutes. Complete subsidence of the low back pain followed, as did the previously noted point lumbosacral tenderness, muscle spasm and painful restriction of motion, for about two to three hours, with gradual return of symptoms to their initial level as the novocain effect subsided. There is no doubt in the author's mind that in these six cases the effect of the novocain injection indicated the source of the low back pain.

In four of these six cases the low back pain came on immediately following mild to moderate industrial trauma, and a diagnosis of lumbosacral sprain had been made in each instance by the referring industrial physician. Therefore, it is believed that this test has medico-legal significance.

As previously stated, all injections were done via the fifth lumbar interspace into the fifth lumbar intervertebral disc. It was fortuitous that the fifth lumbar intervertebral disc was involved in each case. In all six cases the point of maximum tenderness was over the fifth lumbar interspace. In three of the cases an additional clue was provided by radiographic evidence of narrowing of the fifth lumbar intervertebral space. In the event that injection of the fifth lumbar disc did not relieve the symptoms, injection of the fourth would have been performed.

The morbidity and possible complications of introduction of a needle into the spinal canal and into a disc are well appreciated. Consequently indiscriminate injection of a large number of patients with low back pain is not advocated. As previously stated, the great majority of these cases can be diagnosed by the history and physical and x-ray findings, and no further diagnostic procedure is necessary. This test does have value in those cases of low back pain in which the clinical picture has not been sufficiently developed to establish the diagnosis thereby and in which the x-ray findings provide no clue.

TREATMENT

The treatment of a patient with the syndrome of the degenerated intervertebral disc is predominantly but not invariably conservative. Occasionally a case is seen in which the acute episodes of low back pain become so easily and frequently induced, so protracted and so disabling despite the absence of sciatica, that laminectomy and removal of the nuclear material are indicated.

Conservative management consists of the time-honored expedients of rest and support. These measures require no particular elaboration.

Inasmuch as the acute pain stems from internal derangement of the nucleus pulposus within the disc, relief from the pain requires reposition of the nuclear material to its normal location. Unfortunately there is no established and dependable means whereby the nucleus pulposus displaced can be induced promptly to return to its normal location. The rest consists of restriction of activity ranging anywhere from complete bed rest with bilateral Buck's extension traction to mere judicious care in executing certain motions. The severity of the disability automatically imposes the necessary degree of rest. A firm mattress with an underlying fracture board should be employed. Added comfort is obtained from fixing the lumbosacral spine as much as possible by adhesive strapping or a properly fitted corset. Almost invariably the acute symptoms subside eventually. Occasionally some significant degree of disability proves refractory to prolonged conservative treatment and operative intervention becomes necessary.

The patient should continue to use the fracture board, firm mattress and corset for a sustained period following subsidence of the acute symptoms. In many instances the frequency, duration and severity of subsequent acute episodes are minimized. For those patients whose occupations require extensive use of the automobile from which chronic low back pain is derived, I prescribe a variation of the bed board consisting of two pieces of $\frac{3}{8}$ inch plywood of suitable dimensions connected by hinges so as to provide the patient with a firm seat and firm back rest while driving. This purely empiric expedient almost invariably provides appreciable relief.

SUMMARY AND CONCLUSIONS

1. It is the author's contention that the majority of cases of so-called idiopathic low back pain are due to intervertebral disc pathology.

2. The anatomic findings of various investigators are cited to show that there is no disproportion between the incidence of low back pain and the incidence of degenerative processes in the intervertebral discs in comparatively young and healthy adults.

3. Evidence is presented to show that the low back pain without sciatica can be and is attributable to internal derangement within the disc itself consisting of displacement of nuclear material with possible secondary hemorrhage and inflammatory changes.

4. The classical signs and symptoms of the syndrome of the degenerated intervertebral disc are presented and their dynamics discussed.

5. The use of novocain injection into the intervertebral disc as a means of establishing the diagnosis in the equivocal case is presented.

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EVALUATION OF THE RESULTS OF PARTIAL GASTRECTOMY FOR THE TREATMENT OF DUODENAL ULCER*

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PARTIAL gastrectomy continues to be the treatment of choice in the majority of large surgical centers and by most surgeons for those cases of duodenal ulcer which meet the recognized and accepted indications for surgical treatment. Certain standards in technic, amount of stomach to be resected, necessity of removal of the pyloric antrum, closure of the duodenal stump and the creating of a new ostium by gastrojejunal anastomosis has become an established policy in carrying out this form of surgical therapy. In the majority of reports in the current surgical literature the ulcer is also resected. There are some reports which reveal that in 75 per cent of the patients the ulcer is left *in situ*. It is our impression that in these series the long range results are not as satisfactory as those in which the ulcer has been removed.[16]

There exists, however, differences of opinion as to whether an ante or retrocolic anastomosis is more desirable. Each group fortifies their opinions by their results. Also, discussions in favor and against iso and anteperistaltic anastomosis are noted in various reports. The size of the ostium between the stomach and jejunum is likewise discussed fully as to its relationship to the dumping syndrome. Another feature that is stressed by some is the necessity of making the afferent jejunal limb as short as possible in order to reduce the incidence of marginal or jejunal ulceration at the site of the anastomosis, since the experimental work of several investigators has shown that the jejunal mucosa becomes less resistant to the digestive action of the gastric juices, the greater the distance it is from the ligament of Treitz.[22]

In view of these factors we have adopted a procedure which combines the desirable features as outlined previously. We employ an elliptic, transverse, transrectus, supra-umbilical incision in all cases, using silk for closure of the wound. Approximately 75 per cent of the stomach is resected, including practically all of the lesser curvature. In all cases the duodenal ulcer and associated fibrosis are removed. An anterior gastrojejunal anastomosis is performed and in practically all of the patients the afferent limb is sutured to the lesser curvature side of the stomach. In those cases in which the stomach is large and the gastric ostium is wide, the lesser curvature portion of the stomach ostium is closed, allowing for a modified Hofmeister type of anastomosis. The afferent loop is short in the majority of cases, averaging 4 to 5 inches in length. Intestinal No. 00 chromic catgut is the suture material employed for the anastomosis. The majority of the patients are ambulated on the first postoperative day.

TABLE I
INCIDENCE ACCORDING TO AGE

Age	Number
20–29	11
30–39	17
40–49	24
50–59	37
60–69	9
70–79	1
Total	99

This report is based on a study of ninety-nine patients operated upon for chronic duodenal ulcer at this hospital from August 1, 1946, to February 1, 1951. All of the patients have been men from twenty-one to seventy-two years of age. The average age was forty-five and a half years. (Table I.) The greatest number, representing sixty-one patients, occurred in the forty to fifty-nine age group.

The average duration of symptoms prior to

* From the Department of Surgery, Veterans Administration Hospital, Des Moines, Iowa. Sponsored by the Veterans Administration with the approval of the Chief Medical Director. Statements and conclusions published by the authors are a result of their own study and do not necessarily reflect the opinions or policy of the Veterans Administration.

definitive surgery was 8.6 years, the longest period being thirty-five years, and the shortest one year.

Of the ninety-nine patients, forty (40.4 per cent) had a history of at least one massive hemorrhage; twenty (20.7 per cent) had at least one perforation of the ulcer; six (6.06 per cent) had previous gastro-enterostomy; one (1 per cent) had a bilateral infradiaphragmatic vagus resection. (Table II.) Five of the patients had a combination of two of the conditions listed previously. Sixty-two (62.6 per cent) of the patients had one or more of the conditions or complications of their ulcers as noted previously prior to partial gastrectomy.

TABLE II
COMPLICATIONS OF ULCER AND/OR SURGICAL PROCEDURES PRIOR TO GASTRECTOMY

Type	Number
Hemorrhage, massive	40
Perforation of ulcer	20
Gastro-enterostomy	6
Vagus resection, infradiaphragmatic	1
Total	67

RESULTS

Ninety-nine patients were operated upon and of this number, seventy-two (72.7 per cent) have been followed up for a period of from six to fifty-four months. These patients have been admitted to the hospital every six months for the first two years postoperatively and yearly thereafter for comprehensive follow-up studies; 61 per cent of the patients have been followed up over two years. The average follow-up period was 28.2 months. Of the remaining twenty-seven patients, fourteen were lost due to change of address, five were too recent for the first six months follow-up study and eight patients died. There were three postoperative deaths in this series; one occurred on the sixth day and was due to pulmonary thrombosis; one was the result of gastric hemorrhage on the second postoperative day; and one occurred on the twenty-sixth day as a result of pulmonary embolism. A perforation of the duodenal stump developed in this last patient on the third day and a gastric hemorrhage on the sixth day. These complications were followed with pneumonia and cardiac decompensation.

Operations performed in conjunction with partial gastrectomy totaled seventeen in this group of patients; thus 17.1 per cent of the patients required additional surgical procedures to remove or correct associated pathologic conditions. (Table III.)

There were a total of thirty-two postoperative complications occurring in twenty-eight (28.2 per cent) of the patients. (Table IV.) Five of these complications resulted in the death of three patients. Twelve (37.5 per cent) were pulmonary complications. There was only one complication involving the wound and that was a hematoma.

Postoperative gastric analysis studies in fifty-six (77.77 per cent) patients revealed no free acid in the fasting specimen in fifty-one and none after histamine in thirty-five. In

TABLE III
ASSOCIATED SURGICAL PROCEDURES

Operations	Cases
Appendectomy	2
Cholecystectomy	1
Cholecystojejunostomy	1
Cholecystotomy with removal of calculi	1
Diverticulum, duodenal, traction, resection of	4
Excision of marginal ulcer and resection of gastro-enterostomy	3
Meckel's diverticulectomy	1
Resection of gastro-enterostomy	2
Ventral hernioplasty	2
Total	17

TABLE IV
POSTOPERATIVE COMPLICATIONS

Type of Complication	Number
Abscess, intraperitoneal, right upper quadrant*	2
Atelectasis	8
Bleeding, gastric	2
Bronchopneumonia	1
Cardiac decompensation†	1
Cerebral hemorrhage	1
Hematoma, wound	1
Homologous serum jaundice	1
Jaundice, transient*	2
Jejunal (stomal) ulcer	1
Obstruction, efferent loop, jejunum	2
Perforated duodenal stump with fistula‡	1
Perforated duodenal stump with abscess subphrenic	1
Peritonitis, generalized‡	1
Pneumonia	1
Pulmonary, embolism‡	1
Pulmonary, thrombosis‡	1
Shock, secondary to gastric hemorrhage‡	1
Thrombophlebitis, acute, leg and foot	2
Urinary retention and cystitis†	1
Total	32

* Occurred in same patient
† Occurred in same patient
‡ Occurred in patients who died

five cases the fasting gastric specimen revealed 1 to 40 units of free acid. In twenty-one patients there was an increase of free acid from 1 to 40 units after histamine injection. (Tables V and VI.)

TABLE V
POSTOPERATIVE GASTRIC ANALYSIS

Total Number of Cases	Number of Cases No Free Acid		Number of Cases Free Acid	
	Fasting	After Histamine	Fasting	After Histamine
56	51	35	5	21

TABLE VI
UNITS OF FREE ACID—POSTOPERATIVE

Number of Cases	Fasting—Units	Number of Cases	After Histamine—Units
3	1–20	12	1–20
1	21–40	7	21–40
1	Over 40	2	Over 40

Following operation 78 per cent of the patients gained weight whereas 30 per cent revealed no gain in weight. In 98 per cent of the patients there was relief of ulcer pain and 87 per cent showed definite improvement in appetite. A modified diet was followed by 19 per cent of the patients but 77 per cent were free from any dietary restrictions. Although 87 per cent were free from nausea and vomiting, the remainder complained of occasional gastric upset, particularly with overeating.

Bowel habits were normal in 80 per cent of the cases; in 9 per cent the patients complained of constipation and in 7 per cent the patients had attacks of diarrhea. (Table VII.)

The dumping syndrome was severe in one patient, moderate in five and mild but controllable in seven. Although 65 per cent of the patients did not require frequent feedings, 31 per cent required more than three meals a day to maintain or gain weight.

Postoperative follow-up gastrointestinal roentgenographic examinations revealed a satisfactorily functioning stoma with no evidence of obstruction in the sixty-one cases studied. The average emptying time of the gastric remnant was forty-five to ninety minutes. (Fig. 1.)

A marginal or stomal ulcer developed in two patients, an incidence of 2.7 per cent. A large stomal ulcer on the gastric side developed in one man in his early thirties three weeks following gastrectomy. In spite of bilateral vagus resection at a later date the ulcer failed to heal. The patient died eleven months later from massive hemorrhage. In the second case the patient was operated elsewhere for an acute abdomen about one year following gastrectomy. This episode was due to a perforated marginal ulcer. The patient was re-explored at this hospital at a later date and because of increased acids and previous stomal ulcer a bilateral infradiaphragmatic vagus resection was performed. There was considerable scarring about the stoma but no active ulcer was found. Because of the possibility of interference with emptying of the stomach due to these changes and because of the vagus resection, a pantaloon entero-enterostomy was performed at the site of the gastrojejunal anastomosis. This patient has no complaints at this time.

TABLE VII
RESULTS OF FOLLOW-UP STUDY

	Number of Cases
Weight gain	
Yes	48
None or no change	23
Abdominal pain as before surgery	
Yes	2
No	70
Appetite	
Excellent to good	63
Fair	7
Nausea and vomiting	
None	63
Occasionally	7
Diet	
Ulcer diet or modified diet	14
Nonrestricted diet	55
Bowel habits	
Normal	59
Constipated	7
Diarrhea	5
Changing habits (diarrhea—constipation)	1
Dumping syndrome	
Severe	1
Moderate	5
Mild	7

Of the late deaths, in addition to the one described previously, one patient died at home after six weeks; cause was undetermined. One patient died on the seventh and one on the ninth postoperative month as a result of re-

current ulceration in the duodenal stump. In one of these the duodenum perforated twice within a seven-month period resulting in a diffuse peritonitis in each instance, the second of which proved fatal. In the other case the patient expired as a result of repeated uncontrollable massive hemorrhage. The fifth and last late postoperative death occurred in the twenty-eighth month as a result of carcinomatosis. There were no wound disruptions or postoperative incisional hernias in this entire group.

COMMENT

In the over-all appraisal of the results of this series of cases general improvement of the patient with relief of the symptom complex of peptic ulcer syndrome occurred in 87 per cent of the cases followed up. The remaining 13 per cent had a variety of complaints such as occasional nausea and vomiting, failure to gain weight, dietary restrictions, mild epigastric pains, dumping syndrome and complaints as a result of development of marginal ulcer. This percentage of favorable results is comparable to many other series reported in which the operation is similar in scope and/or the anastomosis is retrocolic.

A short antecolic afferent loop has not resulted in any obstruction to the transverse colon and has not interfered with the normal emptying time of the gastric remnant. It is our opinion that an antecolic anastomosis is simple to perform, less hazardous and, if further surgery is required, the anastomosis can be taken down more readily than a retrocolic anastomosis.

The 3 per cent postoperative mortality is considered a fair average for this type of surgery at the present time. Included in this group of ninety-nine patients were eleven patients who were operated upon during or shortly after a massive gastrointestinal hemorrhage. If these patients, who are extremely poor risks and usually carry a higher operative or postoperative mortality than those patients upon whom a partial gastrectomy is performed at an elective time, were excluded from the main group, the over-all mortality would have been lower.

The removal of the duodenal ulcer increases the surgical risk and may result in damage to important adjoining structures. However, we are of the opinion that in spite of this, the over-all long range results will be better if the ulcer is removed. In those reported series in which the ulcer is left *in situ* the incidence of recurrent ulcer syndrome, repeated hemorrhages and perforation has been high.

FIG. 1. Postoperative oral barium studies of the stomach and small bowel following partial gastrectomy. X-ray taken shortly after filling of stomach remnant with barium.

SUMMARY AND CONCLUSIONS

Ninety-nine cases of duodenal ulcer treated with partial gastrectomy are presented. In all cases the ulcer was removed. Gastrojejunal anastomosis was of an antecolic type, using a short afferent jejunal loop. The postoperative mortality rate was 3.03 per cent. The over-all results are considered excellent to good in 87 per cent of the cases which were followed up. There were two cases of marginal or stomal ulcer or an incidence of 2.7 per cent. Atelectasis was the most frequent postoperative complication and occurred in eight patients. There were no cases of wound disruption or postoperative hernia in this series of cases using a supra-umbilical, transverse, elliptic incision. The end results of this antecolic anastomosis are comparable to those reported in those series in which a retrocolic anastomosis was performed.

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ABDOMINAL INCISIONS*

PRESENT STATUS IN THE UNITED STATES

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IN order to obtain information regarding the types of abdominal incisions in use in the United States at the present time for certain common types of operations, during December, 1949, and January, 1950, questionnaires were sent to 1,000 diplomates of The American Board of Surgery. An outline of the abdomen was included with the questionnaire so that the surgeon could diagram the incisions he used. The questionnaire was divided into eight parts. Over one-half of the questionnaires were returned, the exact number of definite answers suitable for inclusion in this survey varying with each part of the questionnaire.

As will be noted in the following, all types of material are used in the closure of the abdominal wall. The sizes of cotton used by different surgeons are given as No. 0, 00, 000, 0000 and 00000. Usually the finer cotton sutures, No. 00000 and 0000, are used for ligatures and suturing the skin, while the heavier sutures, such as 0000 and 000 are used to approximate the muscle and fascial layers.

The catgut, plain and chromic, in use is given as No. 000, 00, 0, 1 and 2. Most surgeons prefer the finer sizes of catgut, while a few sizes No. 1 and 2. The sizes of the silk sutures in use are No. 0000, 000 and 00. The wire sutures now in use are usually stated to be stainless steel No. 28, 30, 32, 34 and 35, No. 32 being the size most commonly used. The non-absorbable sutures are usually interrupted; the catgut sutures are usually used as interrupted sutures in the muscle and fascial layers.

A small percentage of surgeons use two or more types of suture material in the closure of the muscle and fascial layers of the abdominal wall. This usually consists of a continuous suture of chromic catgut re-enforced with interrupted sutures of cotton, silk or wire.

Retention sutures (also called tension and stay sutures) are of heavy material, silk, wire or cotton. These retention sutures ordinarily include the skin, paniculous adiposus and aponeurosis of the external oblique muscle and the anterior sheath of the rectus abdominus muscle. Several surgeons, however, use through and through retention sutures (sutures that pass through all layers of abdominal wall).

The closure of the peritoneum includes the closure of the transversus abdominis muscle, and in vertical rectus incisions the posterior sheath of the rectus abdominis muscle. This is usually effected with a continuous chromic catgut suture; a few surgeons use a double strand of catgut and a few use a plain catgut.

When a vertical rectus incision is employed, the most important fascia and muscles encountered are the posterior and anterior rectus sheaths and the rectus abdominis muscle. The closure of oblique or transverse incision may involve the rectus muscle and its sheaths and usually, also, the external and internal oblique and the transversus abdominis muscles.

A statistical study of the suture materials now in use to close these muscle and fascial layers will be presented in detail. (Table 1.) The type of suture used to close the skin bears no relationship to the type of sutures used to close the deeper structures. Cotton, silk and skin clips are used.

ANSWERS TO QUESTIONNAIRE

What type of incision do you use for cholecystectomy for chronic cholecystitis? (1) One hundred ninety-five surgeons (34.8 per cent) use a right subcostal type of incision (Kocher or Singleton incision) routinely for cholecystectomy for chronic cholecystitis. (2) One hundred ninety-two surgeons (34 per cent) use a vertical incision in the right upper quadrant. The answers to this question were given as upper right rectus, upper right rectus muscle splitting, upper right rectus muscle retracting, mid-rectus and paramedian. (3) One hundred one surgeons (18 per cent) use a transverse incision (Gurd incision) in the right upper quadrant. As a rule the right rectus abdominis

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muscle is divided, but a few surgeons secure adequate exposure by retracting the right rectus abdominis muscle to the left. (4) Seventy-four surgeons (13.2 per cent) state that they use a vertical (right rectus) type of incision when the subcostal angle is narrow, and a transverse or subcostal type of incision when the subcostal angle is wide as in the hypersthenic individual. (Fig. 1.)

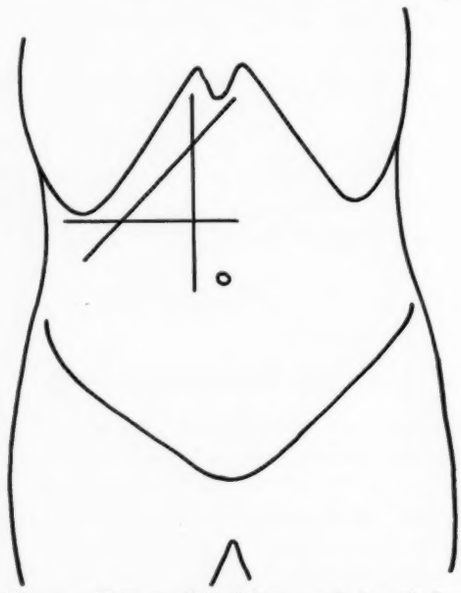

FIG. 1. Types of incision used for cholecystectomy. Right subcostal incision (also called the Kocher or Singleton incision); upper right rectus incision, muscle splitting or lateral retracting (also included in this category are a few midline and a few pararectus incisions); upper right transverse incision (also called the Gurd incision).

Sutures. Cotton, catgut, silk and steel wire are preferred in that order. Ten surgeons state that they use two types of suture material in the muscle and fascial layers. Fifty-five surgeons (9.8 per cent) use retention sutures of silk, wire or cotton. (Table 1.)

Drainage. Four hundred fifty-six surgeons (81.3 per cent) report that they routinely drain the abdomen after cholecystectomy for chronic cholecystitis. The majority of answers to this question was "always." Other answers included "usually," "routinely" or "in the majority of cases." Usually a single penrose drain from Morrison's pouch is brought out through a separate stab wound in the right flank. The time at which the drain is removed varies from one to seven days postoperatively. In answer to this question 105 surgeons (18.7 per cent) state, "no," "usually not," "only when the gallbladder fossa cannot be peritonealized" and "only where there is bile leakage or hemorrhage."

TABLE 1*

Operation	Cotton	Catgut	Silk	Wire	Total
Chronic cholecystitis	192(33.5%)	155(28.2%)	146(26.1%)	68(12.2%)	561(100%)
Acute cholecystitis	171(31%)	187(33.7%)	123(22.3%)	71(13%)	552(100%)
Acute appendicitis	162(28.3%)	258(45.2%)	128(22.5%)	22(4%)	570(100%)
Perforated appendicitis	101(18%)	377(66%)	54(10%)	33(6%)	565(100%)
Right hemicolectomy	179(31.5%)	143(25.2%)	140(24.7%)	100(18.6%)	568(100%)
Anterior resection of rectum	174(30.6%)	140(24.7%)	130(22.9%)	124(21.8%)	568(100%)
Abdomino-perineal resection	155(27.8%)	147(28.1%)	123(22%)	123(22%)	558(100%)
Subtotal gastrectomy	179(32%)	126(22.5%)	145(26%)	108(19.5%)	558(100%)

* The number and percentage of surgeons using each type of suture material for the closure of the muscle and fascial layers of the abdominal wall. This does not include the closure of the peritoneum and skin.

What types of incision do you use for cholecystectomy for acute cholecystitis? There were 561 definite replies to this question. Nine surgeons state that they do not perform cholecystectomy for acute cholecystitis. If operative intervention is required, they perform a cholecystostomy. (1) One hundred ninety-seven surgeons (35.8 per cent) use a right subcostal type of incision (Kocher or Singleton incision) for cholecystectomy for acute cholecystitis. (2) One hundred ninety-one surgeons (34.5 per cent) use a vertical incision in the right upper quadrant. (3) Ninety surgeons (16.3 per cent) use a transverse incision (Gurd incision) in the right upper quadrant. (4) Seventy-four surgeons (13.4 per cent) use an upper right rectus incision in cholecystectomy for acute cholecystitis in long, thin, hyposthenic individuals and a transverse type of incision when operating on the broad-chested, hypersthenic type of patient. (Fig. 1.)

Sutures. Catgut, cotton, silk and wire are used in that order of preference. Eight surgeons (1.2 per cent) use two types of suture material in the closure of the muscle and fascial layers of the abdominal wall. Fifty-two surgeons (9.6 per cent) use retention sutures. (Table 1.)

Drainage. Four hundred ninety-three surgeons (89.3 per cent) state that they routinely drain the abdomen after cholecystectomy for acute cholecystitis while fifty-nine surgeons (10.7 per cent) report that, as a rule, they do not.

What type of incision do you use for appendectomy for non-perforated appendicitis? Five hundred seventy replies to this question were definite and are included herein. (1) Three hundred forty-seven surgeons (60.8 per cent) use a McBurney (gridiron) incision for appendectomy for non-perforated appendicitis. (2) One hundred forty surgeons (24.6 per cent) use a transverse incision. This incision is also known as the Davis, Rockey, Rockey-Davis, Elliot and Sonnenburg incision. It is the same as the McBurney incision except that the skin incision is transverse. (3) Sixty-one surgeons (10.8 per cent) use a lower right rectus type of incision. Included in this group, are all of the vertical incisions used for appendectomy, including the midline, paramedian and pararectus. The pararectus incision is also known as the Battle-Kammerer, Lennander and Jalaguier incision. (4) Twenty-two surgeons (3.8 per cent) use a McBurney incision in the male and a right rectus type of incision in the female when operating for non-perforated appendicitis. (Fig. 2.)

Sutures. Catgut, cotton, silk and wire in order of preference are used to close the muscle and fascial layers of the abdominal wall. (Table 1.)

What type of incision do you use for appendectomy for perforated gangrenous appendicitis? There were 565 definite replies to this question. (1) Three hundred thirty-seven surgeons (59.5 per cent) prefer a McBurney type of incision when operating for a ruptured appendix. (2) One hundred thirty-four surgeons (23.5 per cent) use a transverse incision in the right lower quadrant. (3) Sixty-six surgeons (12 per cent) use a right rectus type of incision. (4) Twenty-eight (5 per cent) surgeons use a McBurney type of incision in the male and a right rectus type of incision in the female. (Fig. 2.)

Sutures. Catgut, cotton, silk and wire are used in that order of preference. (Table 1.) Eleven surgeons (2 per cent) leave the skin and subcutaneous tissue open while another eleven (2 per cent) leave all layers open to the peritoneum performing a secondary closure.

Drainage. Two hundred seventy-nine surgeons (49.4 per cent) state that they drain the abdomen after appendectomy for perforated appendicitis. Of this number, sixty-six (25 per cent) drain only to the peritoneum. Two hundred eighty-six surgeons (50.6 per cent) state that they do not drain the abdomen after appendectomy for perforated appendicitis and of this number, ninety-one (32 per cent) state that they drain only if an abscess is present.

What type of incision do you use for right hemicolectomy? There were 568 definite replies to this question. (1) While the great majority of incisions included in this category are right paramedian, a few pararectus incisions are included. Three hundred forty-six surgeons (61 per cent) use a right rectus incision for right hemicolectomy. (2) One hundred thirty-seven surgeons (24 per cent) use a right transverse incision. The incision may be above, at the level of, or below the umbilicus. (3) Twelve surgeons (2.1 per cent) use an oblique incision for hemicolectomy; four use an incision that parallels the direction of the fibers of the internal oblique muscle while eight surgeons use an incision that parallels the direction of the muscle fibers of the external oblique muscle. (4) Seventy-four surgeons (12.9 per cent) use a right rectus type of incision when operating upon a long, thin, patient and a transverse type of incision when operating on a broad type of abdomen. (Fig. 3.)

Sutures. The suture material used in order of preference is cotton, catgut, silk and wire. Many surgeons who use wire use interrupted sutures which include the peritoneum, muscles and fascia. The Jones figure-of-eight wire suture is quite popular also. Eighty-two surgeons (14.5 per cent) use retention sutures and of this number twenty-seven use through and through (all layers) retention sutures. (Table 1.)

What type of incision do you use for anterior resection of the rectum or sigmoid? There were 568 definite replies to this question. (1) Three hundred fifty-six surgeons (62.7 per cent) use a left rectus type of incision for anterior resection of the rectum and sigmoid colon. Included in this group are left paramedian and

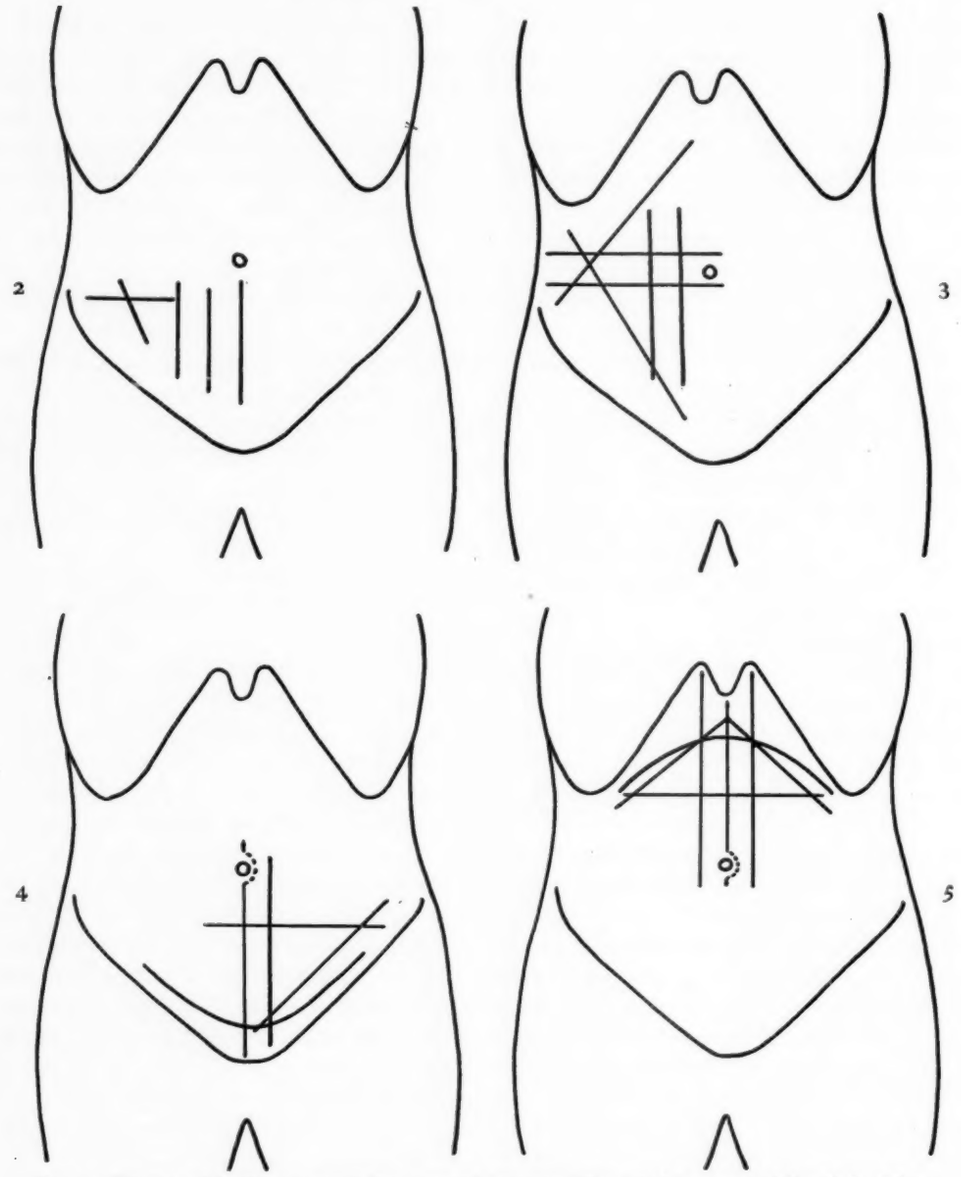

FIG. 2. Types of incisions used for appendectomy. The McBurney (gridiron) incision; the transverse incision (also called the Davis, Rockey, Rockey-Davis, Elliot and Sonnenburg incision); the lower right rectus incision including the midline, paramedian and pararectus incisions (the pararectus incision is also known as the Battle-Kammerer, Lennander and Jalgiuer incisions).

FIG. 3. Types of incisions used for right colectomy. Right paramedian and pararectus incisions; right transverse incision, either supra- or infra-umbilical; oblique incisions.

FIG. 4. Types of incisions used for abdominoperineal resection and anterior resection of the sigmoid colon. The midline incision; left paramedian incision; transverse incision; Cherney type of incision; and the oblique incision.

FIG. 5. Types of incisions used for gastrectomy. The midline incision; the left and right paramedian incisions; transverse incisions; subcostal incisions.

pararectus incisions, the latter being small in number. (2) One hundred six surgeons (18.7 per cent) use a lower midline incision for this operation. If additional space is needed above the umbilicus, the incision is extended around it or the umbilicus is excised and the incision is extended. (3) Forty-one surgeons (7.2 per cent) use an oblique incision in the left lower quadrant, paralleling Poupart's ligament. (4) Thirty-five surgeons (6.1 per cent) state that they use an oblique, transverse or left rectus incision in left lower quadrant depending upon the habitus of the patient. (5) A lower abdominal transverse incision is used by thirty surgeons (5.3 per cent) for anterior resection of the rectum or sigmoid colon. Included in this group are the straight transverse and the curved, (Cherney) transverse incisions. (Fig. 4.)

Sutures. The suture material used in order of preference is cotton, catgut, silk and wire. Seventy-seven surgeons (13.5 per cent) use retention sutures and twenty-three of this number use through and through (all layers) retention sutures. (Table 1.)

What type of incision do you use for Mile's abdomino-perineal resection? There were 558 definite replies to this question. (1) Three hundred thirty-one surgeons (59.3 per cent) use a left rectus type of incision for abdomino-perineal resection of the rectum. This category includes the paramedian and pararectus incisions, the latter being few in number. (2) One hundred fifty surgeons (26.9 per cent) use a lower abdominal midline incision. (3) Thirty-three surgeons (5.9 per cent) use an oblique incision in the left lower quadrant. (4) Twenty-eight surgeons (5 per cent) use a transverse (straight or curved) incision. (5) Sixteen surgeons (2.9 per cent) use either an oblique, transverse or left rectus type of incision, depending on the habitus of the patient. (Fig. 4.)

Sutures. Catgut, cotton, silk and wire are used; retention sutures are used by eighty-four surgeons (15 per cent) with twenty-seven of this group using through and through retention sutures. Sixteen surgeons use a left McBurney incision for the permanent colostomy opening. (Table 1.)

What type of incision do you use for gastrectomy? There were 558 definite replies to this question. Twenty-seven surgeons state that they use a thoraco-abdominal approach of the Humphry-Heaney or Carter type when performing a total gastrectomy or when operating on lesions of the cardiac region of the stomach or lower esophageal region. (1) One hundred thirty surgeons (23.3 per cent) use an upper left paramedian incision for gastrectomy. (2) Ninety-one surgeons (16.4 per cent) use an upper midline incision. (3) Seventy-nine surgeons (14.1 per cent) use a straight transverse upper abdominal incision. Three surgeons use an inverted T incision. (4) Sixty-six surgeons (11.8 per cent) use a curved transverse, upper abdominal incision for gastrectomy. (5) Fifty-seven surgeons (10.2 per cent) use a left subcostal incision for gastrectomy. (6) Fourteen surgeons (2.5 per cent) use a left subcostal incision. (7) Thirteen surgeons (2.3 per cent) use an inverted V incision. (8) Ten surgeons (1.8 per cent) use a right subcostal incision which extends towards the sixth, seventh or eighth left intercostal space. This incision can readily be extended into the thorax. (9) Thirty-one surgeons (5.5 per cent) state that they use a left upper paramedian incision when operating for ulcer or cancer of the stomach and a right upper paramedian incision for duodenal ulcer. (10) Sixty-five surgeons (11.6 per cent) use a transverse type of incision when performing a gastric resection on a broad-chested individual with a wide infracostal angle, and a vertical incision when operating on a narrow-chested patient with a narrow infracostal angle. (Fig. 5.)

Sutures. The first choice of suture material for closing the muscle and fascial layers of the abdomen after gastrectomy is cotton, with silk, catgut and wire, following in that order. Seventy-six surgeons (13.6 per cent) use retention sutures with twenty-two of this number using through and through retention sutures.

EXPERIMENTAL STUDIES USING TANTALUM MESH AS A FULL-THICKNESS ABDOMINAL WALL PROSTHESIS*

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THE difficulties that may be encountered during the operative repair of hernias with marked tissue attenuation and deficiency are well known to all surgeons. In an effort to effect a successful and permanent repair in such cases many technics have been employed. These include the use of silver filigrees, preserved animal fascia, autogenous fascia lata, cutis grafts, polyethylene sheets, stainless steel mesh, vitallium,® fiberglass sheets and tantalum mesh.

Tantalum, the seventy-third element in the periodic table, is relatively inert chemically and when tested by the usual methods of suture implantation in animals evokes almost no inflammatory or foreign body tissue response.[1] It is a very stable element, and to date studies have failed to demonstrate any toxic effects when it is buried in the tissues of animals. Since 1948 articles have appeared in the literature reporting experimental and clinical results with the use of tantalum mesh prostheses for hernial repairs.[2-7] Almost all of these authors dealt with its use as an abdominal wall support rather than as an abdominal wall substitute. An intact peritoneal layer between the tantalum mesh and abdominal viscera was preserved and the mesh simply sutured over the most superficial layer of the fascial repair. The use of tantalum mesh in this manner has thus far proven highly successful, especially in ventral herniorrhaphies.

It is the unusual hernia in which a peritoneal layer cannot be interposed between viscera and fascia or prothesis. However, in cases of abdominal wall malignancy all layers, including peritoneum, may be sacrificed. This poses the difficult problem of reconstruction without tension after variable sized segments of muscle, fascia and peritoneum have been excised. With this thought in mind, we investigated in animals the effect of full-thickness abdominal wall replacement (exclusive of skin) with tantalum mesh, the mesh being placed in direct contact with the abdominal viscera.

TECHNIC

Two kilogram rabbits were anesthetized with intravenous sodium nembutal.® The abdominal wall was shaved, scrubbed with soap and water, and painted with tincture of zephiran. Under aseptic conditions a 12 cm. midline skin incision was made. The skin flaps were widely undermined and a 10 by 5 cm. segment of fascia, muscle and peritoneum was excised. A piece of tantalum mesh 50 by 50 (lines to the inch) of .003-inch gauge was cut to fit the defect and overlap its edges by ¼ inch. The mesh was sutured in place to the anterior rectus fascia using interrupted mattress sutures of No. 40 cotton, the sutures being placed about 1 cm. apart. The skin was then closed over the mesh using a continuous suture of No. 40 cotton and a collodion gauze dressing applied. Eleven animals were so prepared. The animals were sacrificed at intervals of 1, 3, 14, 31, 71, 109, 167, 203, 250, 328 and 362 days for study. X-rays and microscopic examinations of the specimens were made. (Figs. 1 to 11.)

RESULTS

Autopsy specimen demonstrated that fine fibrinous adhesions developed between the abdominal viscera and the tantalum mesh within twenty four hours after implantation. The extent and strength of these adhesions increased as the time of survival was extended. Up to six and a half months of implantation (203 days) the adherent viscera stripped rather readily from the undersurface of the mesh.

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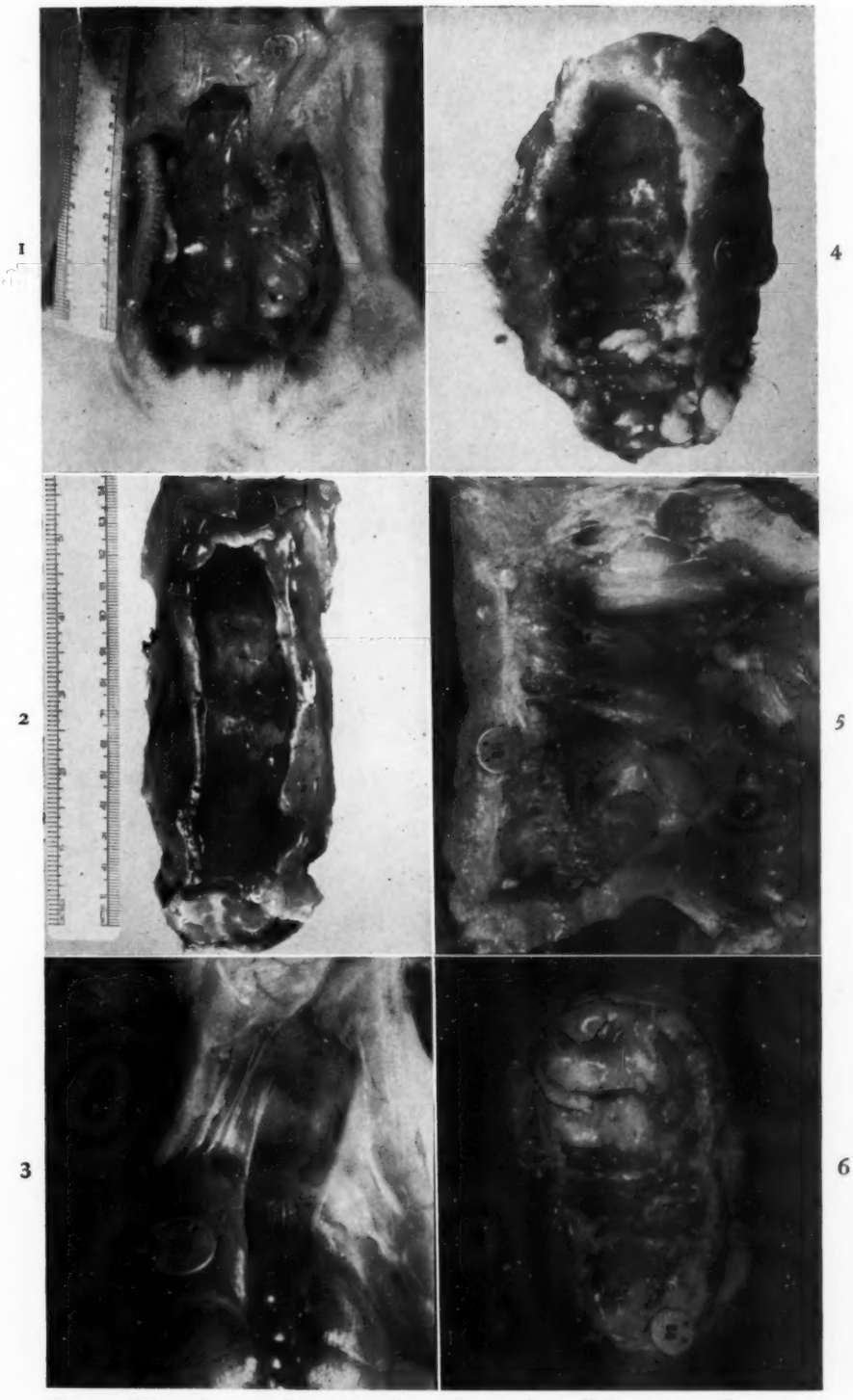

FIG. 1. Three-day specimen showing colon and small intestine adherent to tantalum mesh by fine fibrinous adhesions.
FIG. 2. Three-day specimen demonstrating size of defect and mesh.
FIG. 3. One-month (thirty-one days) specimen with sheet-like fibrous adherence of bowel to tantalum mesh.
FIG. 4. Three and a half month (109 days) specimen demonstrating early "work fracture" of mesh.
FIG. 5. Eight-month (250 days) specimen showing massive firm adhesions between tantalum mesh and abdominal viscera.
FIG. 6. One-year (362 days) specimen with marked fragmentation of mesh.

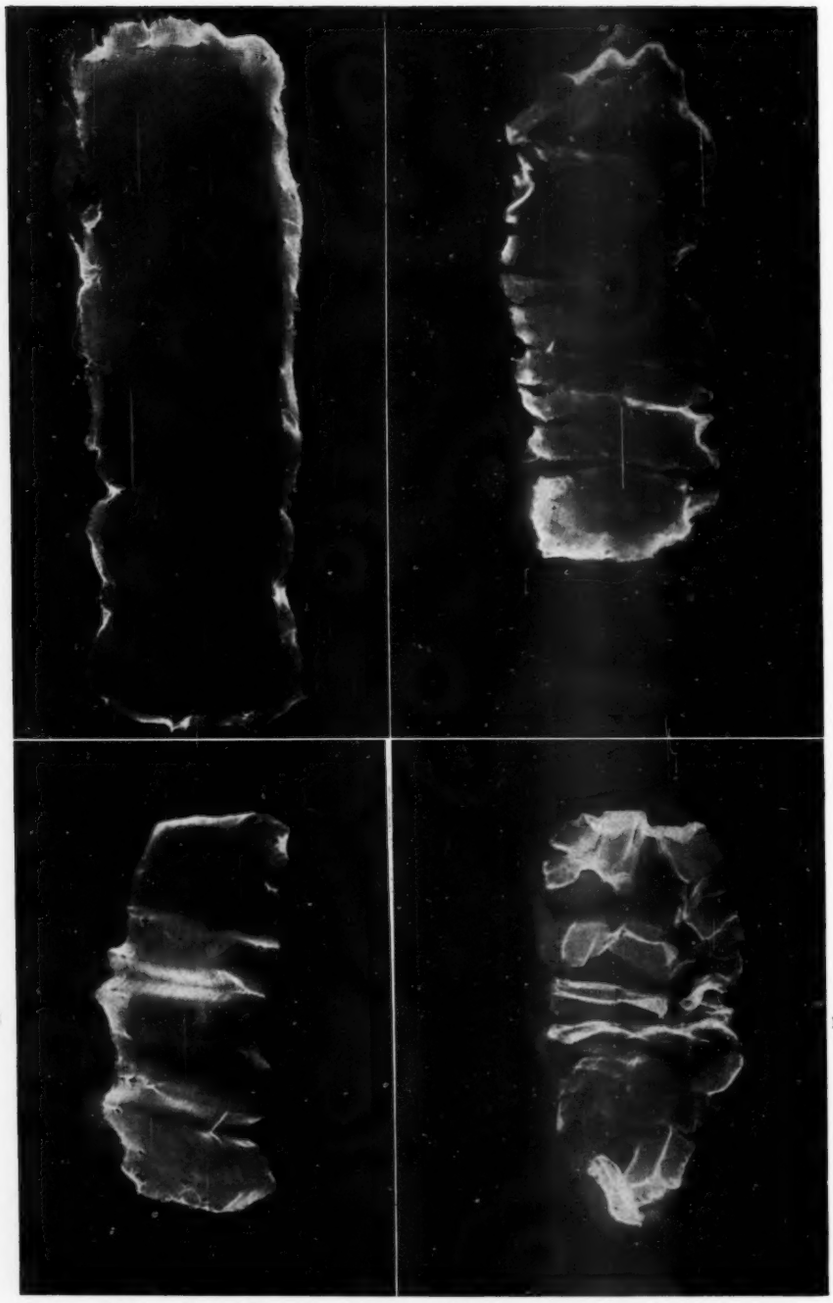

FIG. 7. X-ray of specimen removed on third postoperative day. To assure a more secure early repair the edges of the gauze should be folded over 1 cm.

FIG. 8. X-ray of thirty-one-day specimen which has distortion and crinkling from flexion and extension of rabbit abdominal wall.

FIG. 9. X-ray of specimen removed after eight months (250 days) showing moderate "work fracture" of tantalum mesh.

FIG. 10. X-ray of specimen removed after one year (362 days) demonstrating marked "work fracture" of tantalum mesh.

After this time, however, the adhesions were so dense that they could be separated only by sharp dissection. In no animal in this series did intestinal obstruction develop due to the adhesions.

In no instance did any untoward reaction occur in the skin immediately overlying the mesh. There were, however, two animals in which wound infections developed. One animal showed a small shallow ulcer in the skin directly over the tantalum mesh about thirty days postoperatively. This area was excised and the surrounding skin undercut and approximated. A second animal was sacrificed after fourteen days due to massive subcutaneous wound infection. It is of interest to report that although the space between the skin and the mesh in this animal contained several cubic centimeters of purulent material, the peritoneal cavity showed no evidence of sepsis; even directly subjacent to the mesh this prosthetic and fibrinous sheath acted as an effective barrier to the infection.

After twenty-four hours a fibrinous deposit was demonstrable in the interspaces of the mesh. This became thicker and more dense as the time of survival was extended. From three and a half months on dense fibrosis was noted grossly on both surfaces of the mesh. This fibrous tissue could not be separated from the mesh into which it had grown intimately. Microscopic sections through the tantalum mesh and surrounding fibrous tissue showed in all specimens only slightly varying degrees of intense fibroplasia. Inflammatory cells were scant or entirely absent. No foreign body giant cells were seen in any of the sections.

"Work fatigue" of the tantalum, manifested by fracturing and fragmentation of the mesh, was first noted in the two and a half month (seventy-one days) specimen. The degree of fragmentation increased as the survival time of the animal was extended. We do not believe, however, that this fragmentation materially decreases the integrity of the repair since by the time fragmentation begins there is sufficient fibrous tissue laid down to insure firm support. In no animal did visceral herniation occur through the mesh, even after marked fragmentation of the prosthesis. In one animal, however, herniation did develop at the suture line between mesh and muscle. We believe this was due to the technical error of allowing too great a distance between sutures.

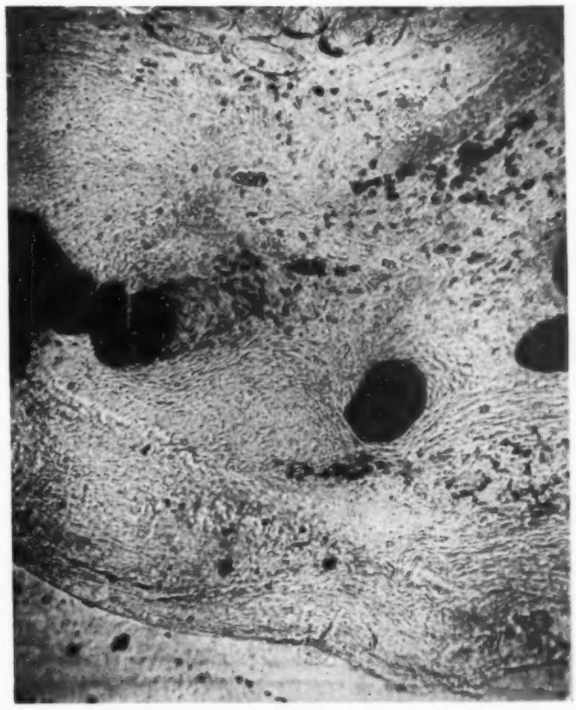

FIG. 11. Photomicrograph of eight-month (250 days) specimen showing marked fibrosis about tantalum mesh wires with minimal inflammatory response.

CONCLUSIONS

Experimental use of tantalum mesh* in rabbits as a full-thickness abdominal wall prosthesis has proven successful. In studies of animals to one year no instance of hernias through the mesh was noted in spite of progressive fragmentation. No disadvantageous tissue reaction, either cutaneous or peritoneal, developed. Massive fibrosis enveloped the mesh and was seen to start as early as twenty-four hours after implantation. This fibrosis resulted in eventual firm adherence of adjacent abdominal viscera to the mesh. Although no intestinal obstruction occurred in this series of animal experiments, the late complication of bowel obstruction as a result of these adhesions must be considered a small calculated risk associated with the intraperitoneal implantation of tantalum mesh.

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The studies of Shumacker and others conclusively prove that sympathectomy is of definite value in the therapy of intermediate and late stages of frostbite and allied injuries caused by exposure to cold. Undoubtedly it is also valuable in many early cases since it tends to make pain, sensitivity and edema subside or disappear and induces quicker demarcation of gangrenous areas. It may even prevent occurrence of gangrene in some early cases, especially the milder ones. Shumacker reported several instances of gangrene of feet due to frostbite which showed very little or no evidence of healing for several weeks after débridement of the gangrenous areas but responded very promptly and healed well after surgical sympathectomy. (*Richard A. Leonardo, M.D.*)

PERIPHERAL THROMBOSIS TREATED WITH ALPHA TOCOPHEROL (VITAMIN E)*

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SINCE our discussion[1] of this topic in a paper read before the Kansas City Academy of Medicine in 1947, as well as in several later reports,[2–6] there has been a good deal of confirmation of the value of alpha tocopherol in thrombophlebitis and phlebothrombosis. This has come from Castagna and Impallomeni[7] as well as Mantero, Rindi and Trozzi[8] in Italy, de Oliveira[9] in Brazil and Sturup[10] in Norway, who have all reported series of patients with acute thrombophlebitis helped dramatically by the exhibition of large doses of alpha tocopherol. Professor Boyd[11] in England, at a recent symposium at the Royal Society of Medicine, has suggested its use in chronic phlebitis.

The experimental background of the idea is also convincing. Zierler et al.[12] at Johns Hopkins and Ochsner et al.[13] at Tulane have indicated that alpha tocopherol is a natural antithrombin circulating in the bloodstream. The Tulane group has used it in surgical cases prophylactically, combined with intravenous calcium, and is convinced of its value. However, the concomitant use of calcium makes this a hospital procedure, is awkward even under such conditions, and we feel is quite unnecessary—as the experiences recounted heretofore would also tend to indicate.

More recently still, Enria and Ferrero[14] of Turin, Italy, have published very convincing experimental studies in this field. They produced thrombosis in an isolated segment of the femoral vein in a controlled series of dogs. Dogs given alpha tocopherol alone showed a tremendous increase of collateral circulation and an absence of inflammatory reaction in the vessel wall at the site of the lesion, as well as some canalization of the clot. Canalization occurred more rapidly and more effectively in animals given tromexan together with alpha tocopherol.

The effect of alpha tocopherol on acute peripheral thrombosis or thrombophlebitis is so dramatic and so readily verifiable by any practitioner that we thought it might be useful to present a few typical case histories here, both of the acute and the much more refractory chronic type. The result achievable in the latter is not nearly as good as could be anticipated but still is occasionally as worth while as is indicated hereafter.

CASE REPORTS

Acute

CASE 1. N. E., a sixty-five year old woman, was first seen by us on September 12, 1950, for hypertensive heart disease. Her blood pressure at that time was 190/130. On initial examination there was a large firm mass which seemed to fill most of the abdomen. It could not be detected on pelvic examination. It was thought that it might be a huge mesenteric cyst. As the mass seemed to be enlarging, an exploratory laparotomy was done on November 17, 1950, at Victoria Hospital. The patient began to fibrillate under the anesthetic but came through the operation very well. A huge retroperitoneal mass filled the whole upper half of the abdomen. No metastasis could be seen. A biopsy was attempted but excessive bleeding forbade it. The wound was closed and deep x-ray therapy was decided on.

On December 6th, as the patient was about to go home after extensive deep therapy, fresh thrombophlebitis about 5 cm. long developed in the upper part of the right femoral vein. There was the usual redness and local heat, with palpable clot. Her platelet count was 242,000, so in spite of the hypertension she was given 450 international units of alpha tocopherol per day. With the patient's consent an invitation to watch her was extended to any physicians of the hospital staff who were interested in following the course of this thrombosis.

By the next day the patient was clinically improved about 50 per cent. On the second day the thrombophlebitis was clinically cured! Indeed, it would have been impossible to

* From The Shute Institute for Clinical and Laboratory Medicine, London, Canada.

diagnose the condition on this day if it had not been seen before; accordingly, the patient was discharged from the hospital! She was urged to continue taking 300 international units of alpha tocopherol per day for the next two weeks in the hope of preventing any recurrence. There was no recurrence and she was well when last seen on December 13, 1951, almost exactly one year after this episode.

CASE II. L. G. was a twenty-one year old woman who had been delivered three times. On September 19, 1948, the day after her last delivery, an abdominal sterilization was performed by the Pomeroy technic. The following day a small area of phlebitis developed in the middle third of the right femoral vein. The platelet count then was 64,000. She was given 400 international units of alpha tocopherol daily and by the 22nd the lesion was no longer recognizable as such without the most careful search. The patient made an uneventful recovery. Her platelet count on September 24th was 242,000. She went home that day, taking her alpha tocopherol for an additional two weeks as prophylaxis against recurrence. There was no recurrence and she has been well since.

CASE III. J. R., a thirty-eight year old woman, had a normal delivery at term on June 2, 1950. She had previously had four children. On this occasion acute phlebitis developed in the right leg on its lateral aspect two days after delivery. No platelet count could be done in the hospital where she was, but she was given 450 international units of alpha tocopherol per day at once. By the 6th the condition had got worse and there was obvious extension to other veins in the leg below the knee. The dosage was accordingly increased to 600 international units per day. On June 8th there was a great deal of improvement and the dose was increased to 750 international units per day. On June 10th she was sent home. There was still slight elevation of pulse and temperature of 99°F. but the leg was immensely improved. The patient was seen again on June 17th in the office. There was no distress in the leg at this time but a small clot could be palpated just behind the right knee. Accordingly she was maintained on a dose of 300 international units per day until the 25th of the month in order to clear up the residual phlebitis and to prevent any exacerbation. Obviously she was inadequately controlled for a recurrence developed on June 26th, at which time the patient spontaneously increased her dose to 450 international units per day. I saw her on the 28th and increased the dose to 750 international units per day. Her platelet count then was 376,000. She convalesced promptly and has been well since.

CASE IV. A. N., a twenty-seven year old woman, had had two normal pregnancies before. In the third pregnancy her last menstrual period began on May 25, 1947. She was taking 75 mg. of alpha tocopherol per day as a prophylactic measure and ran a normal course in the early part of her pregnancy until on August 1st an area of thrombophlebitis 3 inches long developed in the right femoral vein. The patient was confined to her home. It is noteworthy, of course, that this developed while the patient was taking a small dose of alpha tocopherol. No platelet counts were done on her and she was confined to bed for only five days. The dose of alpha tocopherol was increased to 200 international units per day upon diagnosis. The patient made a rather slow recovery. It was not until the 11th that she appeared to be clinically cured and could return for her usual office visits. This of course was one of our early experiences with this treatment and we did not use nearly as much alpha tocopherol then as we have since used. We assume this is the reason for her slow recovery.

Chronic

CASE V. M. M., a thirty-five year old woman was first seen on June 3, 1949. Two years before she had had ligation of the veins in the right leg. Three weeks after this phlebitis had developed which lasted about two weeks. In November, 1948, there had been a recurrence which had kept her in bed for two weeks. There had been four recurrences since. When we first saw the patient, her blood pressure was 122/80 and a Wassermann test was negative. The whole right leg was slightly enlarged. There was so much swelling of the right ankle that she was compelled to split the top of her shoe in order to wear it. There were generalized mild varices in the leg. There was a constant ache in the right hip and shin. Over the shin there was a patch of varicose eczema 4 by 9 cm. in diameter. There was a slight Homans' sign in the right leg but the posterior tibial vein was not tender. There was a scar of a healed ulcer on the inner aspect of the leg above the internal malleolus. The patient could walk no

more than a quarter of a block before persistent discomfort developed in the leg. Fluoroscopy and electrocardiography were approximately normal.

She was given 375 international units of alpha tocopherol per day. When she returned on June 28th, the eczema was much improved, as was the pain in the right hip. Homans' test was now negative.

By September 7th the patient could walk more than a block without discomfort. Her treatment was maintained and by December 17th the leg was almost normal. She discontinued her tocopherol in January, contrary to our advice. On May 11, 1950, she was taken to a hospital in the city where she lived on suspicion of having had a coronary attack. On the seventh day after her admission recurrent phlebitis developed in the right calf. She was next seen by us on May 22nd and given 520 international units of alpha tocopherol a day. On June 22nd she felt well and could walk without difficulty at a good rate of speed for five blocks or more.

Case VI. H. L., a forty year old man, had had phlebitis in his left leg for the previous four years. It began while he was convalescing from an operation for peptic ulcer. When we first saw him on May 27, 1950, he had a blood pressure of 150/118. The Wassermann test was negative. His left calf was much enlarged although it had decreased in size tremendously in the previous two weeks. He ascribed this to fact that he had taken 150 international units of alpha tocopherol per day in that preceding two weeks "on his own." He remarked on May 27th that he could now see his ankles. There was some heat and tenderness over the calf posteriorly but no Homan's sign. Examination of the thigh was negative. The electrocardiogram was normal as was the fluoroscopy.

Since the patient had such a high blood pressure, his dosage of alpha tocopherol was raised very cautiously. Finally he was given 225 international units daily. On June 9th his blood pressure was 140/100 and the leg was still less edematous. He was now able to walk four and a half miles slowly. This man has remained as well since.

COMMENTS

Much depends on the level of dosage, as could be anticipated. Nowadays we never attempt to handle such patients on the lower dosages we once used. To get consistently satisfactory results one must approach 500 or 600 international units of alpha tocopherol per day from the initiation of treatment. Indeed, thrombosis can first show itself while smaller doses are being given. Progress can be followed by means of platelet counts. If progress is nil or slow, the dosage of tocopherol should be increased until a level is reached at which healing occurs rapidly.

For some reason puerperal patients have been helped more dramatically and rapidly than others we have seen. It may be that these approximate phlebothrombosis rather than thrombophlebitis. However, a more likely explanation is that these patients are so closely and regularly scrutinized in the puerperium that thrombosis is recognized and treated with greater promptness. Moreover, their youth, good blood vessels and general good health are in their favor, and permit prompt and massive dosage.

We do not now immobilize patients during treatment unless the lesion is very acute and extensive. We no longer have any apprehension of embolism although theoretically such a danger is always present in the resolution or dissolution of thrombi by any fibrinolytic agent.

Alternative anticoagulants now widely used, such as heparin and dicumarol,® have so many important disadvantages, as everyone knows, that we believe they should be replaced by alpha tocopherol. The latter is much cheaper, infinitely safer, can be taken at home by the patient himself and reveals none of the dangers or difficulties accompanying alternative treatment.

We might add a word on platelet counts. When these are low, we anticipate that the thrombosis will rapidly respond to high dosage alpha tocopherol, clinical improvement often being discernible in a matter of two or three days, for example. There is a concomitant rapid rise of the platelet count. Where neither of these occurs, we merely increase the dose until both the thrombus resolves and the platelets increase, for we have never seen a thrombocytopenia of any type that did not respond to a high dosage of alpha tocopherol. This applies to purpura[15,16] as well as to thrombosis. Other authors[17–19] have commented on the thrombocytogenic effects of alpha tocopherol.

However, when the initial platelet count is normal or near it, we anticipate a slower or slight clinical response. In such patients we are tempted to use massive doses of 600 to 800 international units per day from the outset.

Presumably the problem is explainable on some such theory as this: Where the fibrin net in the vein is fresh, it can screen the platelets out of the circulation rapidly and fairly thoroughly. Correspondingly, if an effective fibrinolytic agent can be administered in time, such a clot should resolve readily and liberate the retained platelets before they are severely damaged. On the other hand, a clot already partially organized and fibrotic may have retracted partially to permit more circulating platelets to pass and may not hold what platelets approach it. The platelet count, therefore, may not be depressed, but this thrombus has already become a difficult and more chronic problem.

May we say that in our experience the influence of massive doses of alpha tocopherol on a fresh thrombosis is so dramatic and rapid that one has but to see it once to be forever convinced. The safety and ease of a method which can be used in or out of hospital, and which in our experience is as effective in prevention as in treatment, should appeal to every physician familiar with the dubious alternatives. Especially should this be true for patients apprehensive of recurrences or those too poor to justify hospitalization. In any case, this treatment should liberate many a hospital bed and avoid the chronic invalidism that so often ensues upon an episode of thrombosis.

We rarely expect benefit from tocopherol therapy in patients whose thrombosis occurred more than five years before, and of course, the value of the treatment varies inversely with the age of the lesion. However, pleasant surprises do occur and may occasionally be anticipated even in lesions of long duration.

One final word should be said on reliable products. Good results may be attained only with large dosage of good products—those labelled in terms of the League of Nations' standard, dl-alpha tocopherol acetate. The market in the United States is flooded with preparations improperly labelled and of dubious potency. Fortunately this problem has been overcome in Canada by Federal enactment. When inferior preparations are used because of price or other factors, one gets no or little result; and this, of course, discredits the mode of treatment. Ochsner has seen fit in his papers to name the product he uses; presumably because he has encountered such a formidable difficulty so generally. We in our turn would like to say that our work was done principally with E-ferol (Testagar & Co., Inc., Detroit, Mich.) and Vita-E (Webber Pharmaceuticals Ltd., Toronto, Can.).

SUMMARY

Alpha tocopherol (vitamin E) is very useful in the management of peripheral thrombosis or thrombophlebitis, especially in the more acute forms.

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Cattell has emphasized (and now Loggan and Kleinsasser confirm his conclusions) that pancreaticoduodenectomy is an ideal operation for cancer of the papilla of Vater, especially if localized, but that its end results are unsatisfactory in the surgical treatment of cancer of the head of the pancreas. Loggan and Kleinsasser reached this conclusion after a careful analysis of the results reported in the literature on all cases of pancreatic cancer. The results were also unsatisfactory, they found, when this operation was performed for cancer of the lower end of the common bile duct or for duodenal cancer other than that arising in the ampulla of Vater. (*Richard A. Leonardo, M.D.*)

EFFECTS OF ACTH AND CORTISONE ON REFRIGERATED HOMOGRAFTS IN THE EXPERIMENTAL ANIMAL*

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THERE has been some evidence that the survival of homografted skin can be controlled or prolonged, or permanent survival made possible by a mechanism based on an antigen-antibody reaction.[1-2] ACTH and cortisone have been reported to control the immune response,[3] and so it has been postulated that these compounds may control or prolong the survival of homografts.[4]

Baxter, Schiller, Whiteside and Straith[5] have reported that ACTH had no effects on prolonging the survival of homografts. Ellison et al.[6] have also reported no prolongation of the survival of homologous skin grafts by ACTH and cortisone.

The author has reported that homografts refrigerated in 10 per cent serum based on tissue culture methods prolonged the survival of these grafts in the experimental animal.[7] There is evidence that cells grown in tissue culture or removed from their environment in a viable state lose their individuality and can be successfully and permanently transplanted.

The purpose of this experimentation was to determine the effects of ACTH and cortisone given to the recipient on the survival of refrigerated homografts stored in 10 per cent serum by attempting to interfere with the immuned response of the recipient animal and the role that the immune response plays in homografting.

METHODS OF STUDY

Grafting of skin on the abdomen of rabbits was selected as the method for operative work. Full thickness skin grafts measuring 4 to 6 cm. were used for study in these experiments. When the skin was to be transplanted, the animal was anesthetized with Dial† 0.5 cc./kg. and a refrigerated homograft stored in 10 per cent serum at 0 to 8°C. was implanted.

The animals to receive the graft were treated with varying doses of cortisone ranging from 1–1.5 mg./kg. to 10–12 mg./kg. daily and ACTH ranging from 10–40 mg./kg. daily.‡ Untreated animals were used as controls.

These areas were examined daily after the sixth postoperative day to observe the percentage of success and the amount of contracture. The per cent success was measured by dividing the new area of epithelium into the total area denuded. The amount of contracture was measured by noting the amount of shrinkage of the graft. At different intervals these areas were removed for microscopic examination.

RESULTS

In the animals treated with 10 to 12 mg. of cortisone daily, the refrigerated homografts showed marked deterioration and necrosis. (Fig. 1.) Microscopically these grafts showed marked deterioration of the epithelium with a heavy inflammatory exudate made up predominantly of lymphocytes. (Fig. 2.) These animals showed marked dependent edema of their extremities, increased amount of fluid in their peritoneal cavity, hepatomegaly and atrophy of the adrenals. Similar results were obtained with use of 40 mg. of ACTH daily, except that the adrenals were not atrophied.

In the animals treated with 4 to 8 mg. of cortisone daily, the grafts healed by primary intention. There were no contractures noted in the grafted areas. The grafts were not uniformly successful; they took with relative success except one graft in an animal treated with 6 mg./kg. daily which melted away at forty days. (Fig. 3.) Microscopically these areas were composed of four to six layers of epithelium with peg formation. (Fig. 4.) Hair follicles and glands were absent. Those animals treated with 15 to 20 mg. of ACTH daily showed similar results.

† Product of Ciba Pharmaceutical Products, Inc., Summit, N. J.

‡ The ACTH and cortisone used in these experiments was generously supplied by Dr. J. M. Johnston of the Medical Service, Mercy Hospital.

* From the University of Pittsburgh School of Medicine, Mercy Hospital, Pittsburgh, Pa.

FIG. 1. Refrigerated homograft ten days after implantation; recipient treated with 12.5 mg./kg. of cortisone daily.

FIG. 2. Refrigerated homograft ten days after implantation, cortisone treated.

In the animals treated with 1 to 4 mg./kg. of cortisone daily and 10 mg. of ACTH daily, the transplants behaved similarly to those of the control animals.

COMMENTS

Massive or large doses of cortisone and ACTH may have an injurious effect on refrigerated homografts in that they will produce marked deterioration and necrosis of the grafted areas. These massive doses will usually produce toxic side effects such as water retention, hepatomegaly and, in the case of cortisone, atrophy of the adrenals.

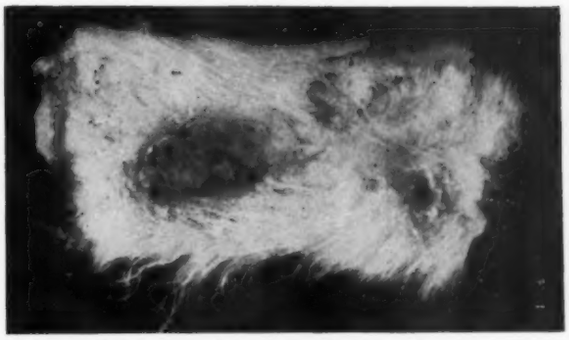

FIG. 3. Refrigerated homograft forty days after implantation; recipient treated with 6 mg./kg. of cortisone daily.

Moderate or therapeutic doses of ACTH and cortisone have little or no effect on the rate of healing of refrigerated homografts. They took with relative success, but did not differ from those grafted on the untreated animals.

There are indications that cortisone and ACTH may inhibit the effects of allergic phenomena not by some mechanism specifically related to the antigen-antibody response, but rather through its general antiphlogistic action. Evidence which supports this view is that acute inflammation produced by trauma are inhibited as well as those originating from chemical stimuli.[8]

If ACTH and cortisone do interfere with the antigen-antibody response, their failure to increase the survival of homografts suggest that the survival of homografts depend on the genetic differentials inherent in the cells of the transplanted tissue.

CONCLUSIONS

The effects of ACTH and cortisone on refrigerated homografts stored in 10 per cent serum have been studied. ACTH and cortisone exert the following effects on refrigerated homografts stored in 10 per cent serum: (1) They prevent contractures in grafted areas. (2) They do not delay the rate of healing of homografts in therapeutic doses. (3) They have little effects on the survival of the homograft and do not interfere with local antigen-antibody mechanism. (4) They will produce deterioration of all

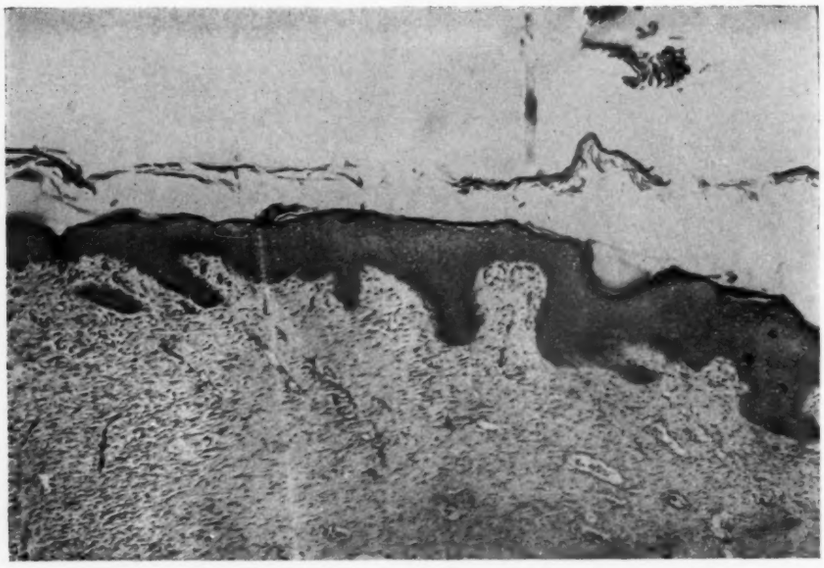

FIG. 4. Refrigerated homograft forty days after transplantation; recipient treated with 10 mg. of ACTH daily.

skin transplants in massive large doses, also producing water retention, hepatomegaly and, in the case of cortisone, atrophy of the adrenals.

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MANAGEMENT OF VARICOSE VEINS AND THEIR RELATED PROBLEMS*

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THE problem of treatment of varicose veins continues to evade complete solution. Most of the methods of treatment used today are merely refinements of the methods which have been used in the past. Nearly 2,500 years ago Hippocrates was against the incision of a superficial varix because he had observed that such treatment frequently caused large ulcers to appear. Those tempted to smile at the various methods of faith healing of varicose veins used in the past must remember that nature cures, faith healing and wonder drugs for the cure of varices still tempt the patient from modern rational treatment. Not long ago one of our medical columnists quoted in his syndicated newspaper column from an article of mine on the treatment of varicose ulcers. Within the next week I had received several hundred letters from all over this country requesting a jar of my magic ointment. Plutarch's Lives, written in about 86 B. C., mentions the first surgery applied to varicose veins. At this time the patient had had the vein in one leg tied off; but when the surgeon went to the other, he declined to have it done, saying, "I see the cure is not worth the pain." The injection treatment was instigated by the invention of the hypodermic syringe 100 years ago, but it was not until about forty years ago that the operative and sclerosing methods of treatment were used in combination.

It is only during the past seventy years that surgery has been used to any extent for the treatment of varicose veins. Schede in 1877 advocated occlusion by multiple ligation and section of varices by precutaneous ligation. Madelung in 1884 described a radical but effective operation which consisted of complete excision of the internal saphenous vein and varicose radicals through a long incision in the thigh and leg. Early in the 1900's the first of a series of enucleation procedures for the removal of segments of veins appeared. Keller proposed removal with a wire inserted through the vein lumen and C. H. Mayo described his perivascular stripper. The Babcock stripper, a modification of the Keller device, using a rigid wire with an olive tip appeared shortly thereafter.

In 1908 Friedel and Rindfleisch proposed their mutilating spiral incision of the lower leg with open packing and healing by second intention. In 1916 Homans advocated ligation at the level of the saphenofemoral junction to discourage the development of the collateral circulation. DeTakats in 1930 made a notable contribution when he suggested ambulation immediately following ligation to decrease morbidity and mortality.

The foregoing remarks have reviewed some of the historical highlights in the treatment of varicose veins, and it immediately becomes obvious that no single satisfactory cure was developed during this entire period. At the present time in the definitive treatment of varicose veins we utilize two therapeutic methods, injection and surgery. Some very satisfactory sclerosants were developed in the 1920's, and this method became the treatment of choice until approximately the middle 1930's when the surgeon again advocated the combination of injection therapy with an adequate high ligation of the great saphenous veins.

In any consideration of the present day treatment of varicose veins the need of an accurate diagnosis and complete appraisal of the venous system in the lower extremities is paramount. We have several alternative methods of treating varicose veins surgically, each with a fair promise of success. A simple diagnosis of varicose veins will not suffice. It is necessary to determine the competence of the great and lesser saphenous systems, the communicating veins and the deep system, as well as noting the nutritional state of the skin. At the same time it is important to carry out a complete

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general examination of your patient and to determine the general and local status of the arterial circulation.

Varicose veins can be classified in many different ways, but primarily classification is based on the presence or absence of an incompetent great or lesser saphenous system or both. Injection therapy may suffice for the treatment of those varicose veins without valvular incompetency but in the main more than 80 per cent of the patients with varicose veins will have an incompetency of the superficial venous system and will require some form of surgical therapy. These are the cases to which the remainder of my remarks throughout this article will be devoted.

Three general plans of management are currently advocated by their prospective preponents. They are in order of popularity: (1) resection and injection; (2) multiple or segmental ligation, with or without injection; and (3) stripping of the main channels of the incompetent system. Comparison of the end results of these methods as reported in the literature is difficult because there has been such a tremendous variation in the individual grouping of the cases. During the past twenty years I have treated hundreds of patients with varicose veins by these different methods, and I have found each to have relative merits. My cases were carefully studied and the type of surgery instituted selected for the individual. In the middle thirties I believed that an adequate combined division and ligation of the great saphenous veins at the saphenofemoral junction together with subsequent injection therapy would completely correct the problem in better than 90 per cent of the cases. This was true, but the effective cure rate does not remain at 90 per cent throughout the years.

At this time I described a technic for this operation and I think it is still the most important part of our treatment today. An accurate combined division and ligation of the great saphenous veins at the saphenofemoral junction, together with separate division and ligation of the uppermost tributaries is performed. This procedure is frequently associated with simultaneous injection of sclerosing solution into the isolated great saphenous vein and at the same time a ligation of the lesser saphenous vein just posterior to the knee was performed in more than 20 per cent of the cases. Subsequent to this the remaining varicosities were completely obliterated by additional sclerosing solution.

Following a high ligation of the saphenous vein some have reported an incidence of recurrence of more than 30 per cent. As a matter of fact, following any type of surgery for varicose veins, there is a definite incidence of recurrence but it has been my experience that this recurrence rate can be exceedingly small. For the most part recurrence in any group can be prevented if the many variations in the anatomic relationships of the great saphenous vein to its tributaries in the fossa ovalis are recognized. In 1940 Heyerdale and I discussed several of these variations. In many instances recurrences were secondary to failure to ligate the uppermost tributaries with a resulting shunt around the site of ligation of the saphenous vein. In other instances the lateral or medial femoral vein had been mistaken for the saphenous vein following its supposed ligation. In others the saphenous vein was ligated at too low a level. In some instances anatomic variances in the tributaries was the explanation for the recurrence. In a few it was my belief that had a segment of the ligated saphenous vein been excised recurrence might have been prevented. Many other factors were noted and it should be mentioned that what is said about recurrence following simple division and ligation of the great saphenous vein can be applied to the procedure of stripping and segmental excision.

It has always been my belief that too much stress has been placed on the presence or absence of communicating veins, as in most cases such situations can be handled by adequate sclerosing. However, in many patients who have had a deep thrombophlebitis with resulting compensatory superficial varicosities the communicating veins will be found to have dilated considerably. In these cases I think if only high ligation of the great saphenous vein is to be carried out that separate divisions and ligation of the communicating veins should also be performed.

There is some merit to be said in favor of segmental division and ligation of the saphenous system for individuals with advanced varicosities and markedly dilated saphenous veins. One can segmentally divide and ligate these veins, treating the individual segments in accordance with the patient's reaction. I found that segmental ligation was a very satis-

FIG. 1. Intraluminal stripper in place for stripping.

factory procedure and I began doing more and more of these, particularly in the extensive cases and those with associated ulcers. However, this operation was time-consuming, was disfiguring because of multiple incisions and carried nearly as great a recurrence rate as did the simple ligation previously discussed.

During the past ten years I have been doing some stripping operations; and although during the past few years I have continued effectively to use the operations just as discussed, I have done a stripping operation in the vast majority of my cases. As I have already mentioned the stripping of varicose veins was introduced to the medical literature in 1900 by C. H. Mayo with his extraluminal stripper and in 1906 by Keller with an intraluminal stripper. It is surprising that the stripping of varicose veins never gained a great deal of popularity until recent years. This may have been due to the fact that it carried a high morbidity and a moderate mortality. At the same time it was associated with a fair number of recurrences, primarily because the stripping was not started at a high enough level. As I have said, the primary part of the stripping operation is an adequate high ligation of the saphenous vein at the saphenofemoral junction. The great saphenous vein can be stripped from the leg down to and below the inner aspect of the ankle. (Fig. 1.) Frequently a stripping of the lesser saphenous vein should be done. These strippings require the use of either an intraluminal or an extraluminal stripper. All of these strippers have certain merits, and it is advisable to have several types available so that they can be interchangeably used in the same case. I do not wish to give the impression that the stripping operation is the ultimate treatment for varicosities, but I do think that it is the best treatment we have so far.

A frequent condition seen by one interested in the treatment of vascular problems is the indurated or ulcerated leg. By an indurated leg I mean any hardness or thickening of the skin and subcutaneous tissue resulting from edema. Usually there is a chronic, long-standing edema and subsequently a low grade inflammatory condition which develops in the region of the ankle. This produces a hard, brawny induration in the skin and subcutaneous tissue. (Fig. 2.) This may involve only a small plaque at the inner aspect of the ankle or it may extend over the entire circumference of the lower leg and is frequently associated with ulcer formation. (Fig. 3.)

Ulcers may develop in the lower extremities from many causes, such as infection, inadequate vascularity, venous congestion, vascular trauma, burns, malignancy, allergic manifestations, drug reactions and vitamin deficiency. They are of two main types, arterial ulcers and venous ulcers. It is important that a careful differential diagnosis be made as to the etiologic factors present before attempting therapy. Altogether too frequently all ulcers are classified together and treated by some standard form of therapy. It is not uncommon that an ulcerated leg has several factors responsible for its development, and all of these factors must be individually treated if the problem is to be satisfactorily corrected.

Ulcers which are due to occlusive arterial disease usually occur at the periphery of the toes, tips of the fingers and over the heel and at times are secondarily precipitated by some slight trauma. An important function of the circulation is to provide for nutrition of the tissues. The metabolic needs of the skin have been estimated to amount to 1 to 2 cc. of blood for 100 cc. of tissue per minute. This is indeed a very minute amount. In contrast it has been

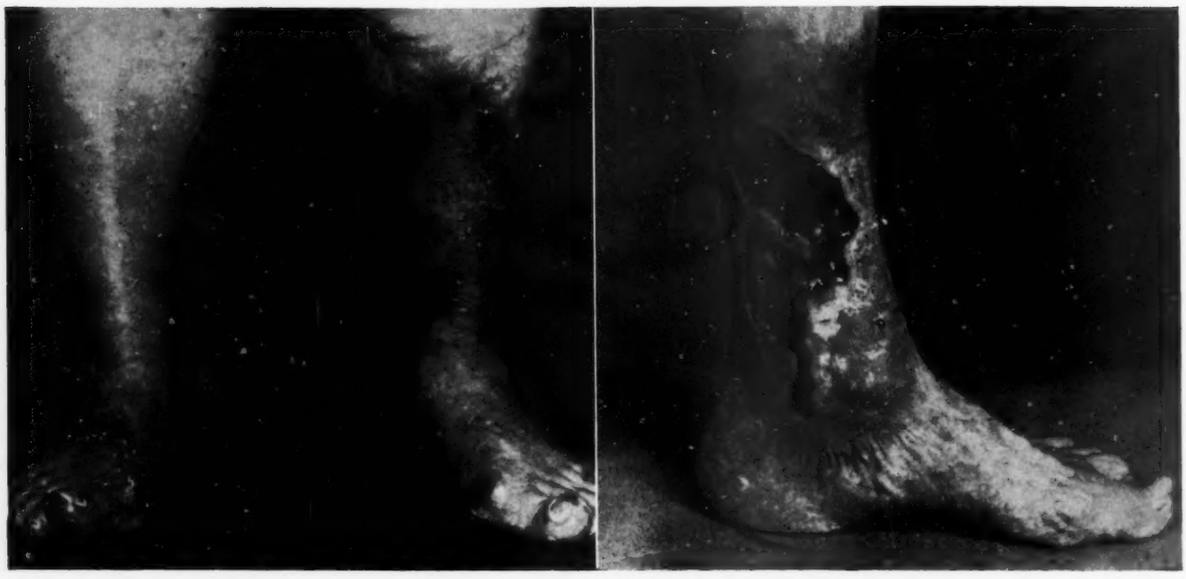

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FIG. 2. The typical indurated leg.

FIG. 3. Stasis ulceration associated with induration.

shown that the blood flow through the same skin of a normal subject during full dilitation may reach as much as 90 cc. per minute. Similarly, the rate of blood flow to the extremities as a whole during full dilitation has been calculated as 25 cc. per minute for 100 cc. of tissue. From these figures it can be seen that the arteries supplying the skin have to be practically occluded in order to harass the nutrition of the skin. Any patient in whom vascular disease develops but who has no initial symptoms, such as claudication, and starts off with skin lesions only is one whose prognosis has to be viewed with the gravest concern. Usually when ulcerations such as those shown in Figure 4 occur, more than one etiologic factor is present. In this particular case there was a large amount of arteriosclerosis associated with diabetes, obesity and a general rundown condition, but under conservative therapy the ulcer was completely healed.

It is not uncommon for the individual with thromboangiitis obliterans or Buerger's disease to be treated primarily as a venous problem because of the development of a superficial thrombophlebitis. I have seen several of these patients who have had superficial vein ligations with no great amount of improvement, and when the proper diagnosis has been made and a sympathectomy carried out, startling improvements have been obtained. Arterial venous fistulas, either congenital or traumatic, may produce a picture similar to that of chronic venous insufficiency and secondary ulcerations develop, which may at times be confusing as to the exact diagnosis. Syphilis, malignant disease and vitamin deficiencies are more commonly etiologic factors in the production of ulcers on the extremity than one usually thinks. The tissue vitality of the skin in the region of the ankle is perhaps the lowest for any region of the body. Incised wounds heal slowly here, bruises disappear less rapidly and swelling has a tendency to persist longer. As a result any infection from an open wound in these regions is apt to heal very slowly.

Ulcers such as shown in Figure 5 may arise due to local infection. Certain strains of strepococci have a specific action on the skin seeming to digest it away. Other fungus organisms, alone or with others, have this irritating digestive action also.

Irradiation used extensively can occasionally participate in the non-healing of wounds. In Figure 6 is a chronically infected ulcer of the lower extremity of fifteen years' duration which followed the treatment of a supposed malignant condition involving the periosteum of the bone. Following control of this infection together with improvement of the arterial and venous circulation by a stripping of the incompetent venous system, and subsequently

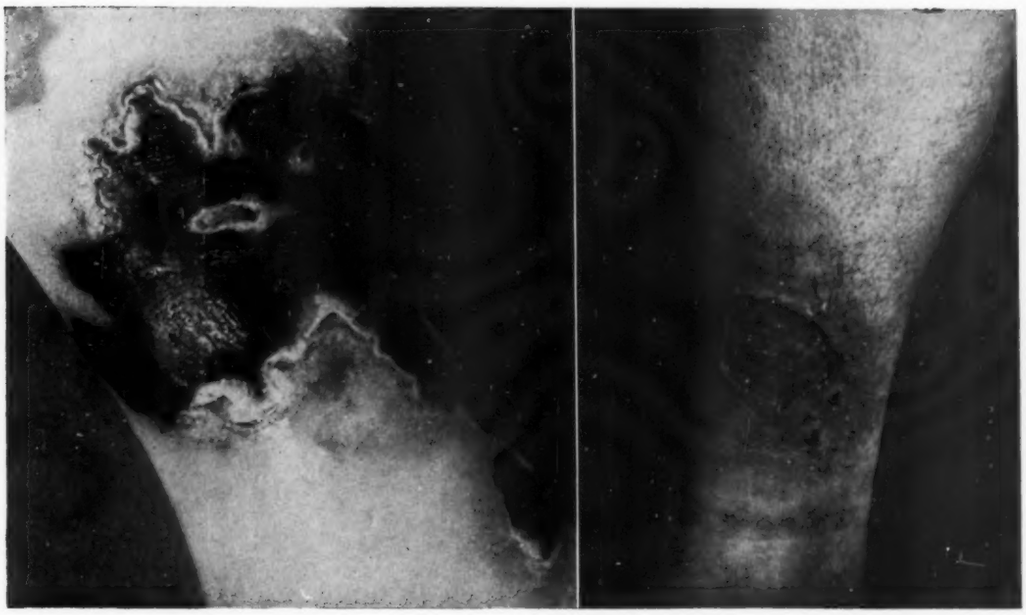

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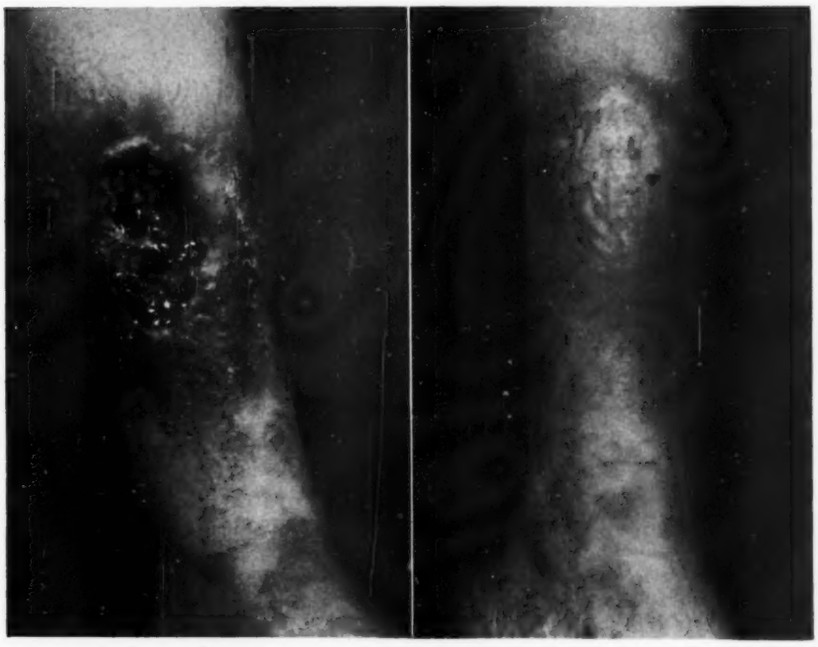
FIG. 4. Gangrenous ulceration which was healed by conservative treatment.

FIG. 5. Ulceration due to local infection.



6 7

FIG. 6. Ulceration of fifteen years' duration secondary to irradiation.

FIG. 7. Ulcer shown in Figure 6, eight weeks after grafting.

applying a full thickness skin graft to the defect, the ulcer was completely healed. (Fig. 7.)

Venous ulcers are of two types, those secondary to the simple varicose veins and those secondary to thrombophlebitis. Simple varicose veins will be the cause of an ulcer in approximately 25 per cent of all patients who have varicosities. I think that it is important in our treatment of these individuals with varicose

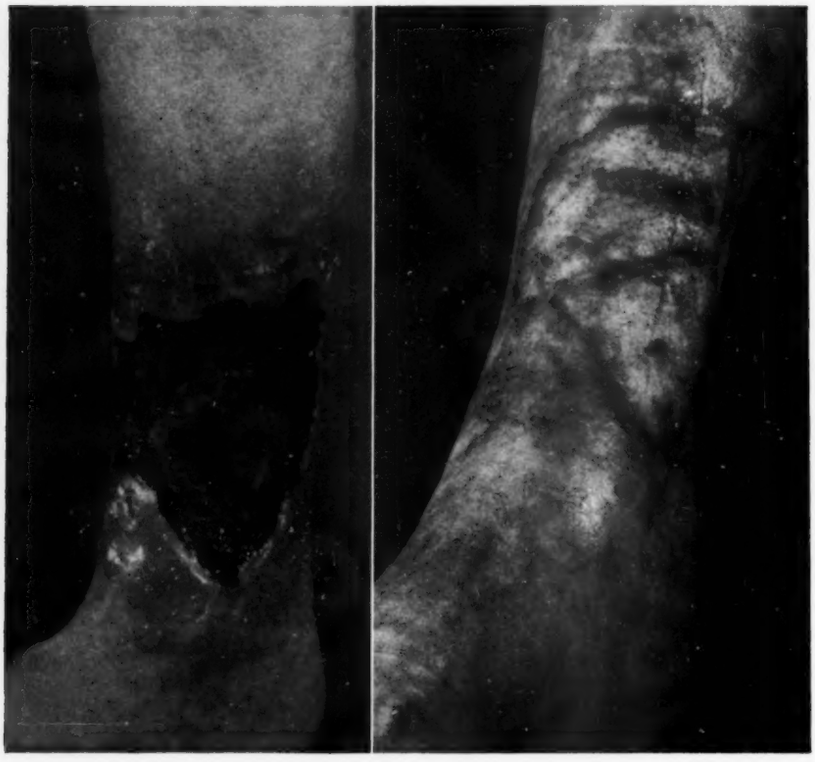


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FIG. 8. Infected post-thrombophlebitic ulcer.

FIG. 9. Ulcer healed five weeks after vein stripping and skin grafting.

10 11

FIG. 10. Varicose ulcer before excision.

FIG. 11. Varicose ulcer four weeks after excision and skin graft.

veins or with thrombophlebitis or an early ulcer that we consider not only the present but also the future possibilities of the case. One must recognize that these diseases are chronic and progressive in nature unless adequate treatment is instituted. In Figure 8 we see a large chronic stasis ulcer which has been present for more than six years in a diabetic with hypertension, varicose veins and chronic phlebitis. Following control of the diabetes a stripping of the great and lesser saphenous systems, with control of the infection and treatment of the general problem, it was possible to apply a full thickness skin graft and to obtain a complete take. In Figure 9 the situation as it existed approximately one month following the operation is shown.

Occasionally it is possible to excise stasis ulcers completely, together with the surrounding area of induration and to close the entire area by undermining adjacent skin flaps. I have done this in several cases with a great deal of success. In others of somewhat longer standing and of a post-thrombophlebitic nature in which the ulcers have recurred a number of times, and in which the induration is marked, extensive excision of this whole zone including the bed of the ulcer through the fascia layer and down to the muscles with replacement of a full thickness skin graft has given most gratifying results. In Figure 10 we see just such an ulcer which was completely excised and at the same time a stripping of the superficial venous system was carried out and a full thickness skin graft applied. A complete graft of the ulcer was accomplished and Figure 11 shows the end results within approximately four weeks time.

SUMMARY

A discussion of some of the current opinions in reference to the management of varicose veins and the related problems has been made. An adequate combined division and ligation of the great saphenous vein at the saphenofemoral junction is the basis of all surgical treatment today. This combined with the stripping operation is not the ultimate treatment for varicosities but it is the best treatment so far. Various factors in the diagnosis and treatment of the indurated and ulcerated leg have been discussed. Each vascular problem must be considered as an individual case and all measures available should be utilized in their treatment.

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LUMBAR SYMPATHECTOMY IN PERIPHERAL VASCULAR DISEASES*

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LUMBAR sympathectomy was performed on seventy patients with various peripheral vascular diseases. The lumbar chain consisting of ganglia L2 and L3 was removed. In over 50 per cent of the cases the procedure was accomplished bilaterally. The cases were divided into four categories consisting of (1) arteriosclerosis with diabetes, (2) arteriosclerosis without diabetes, (3) Buerger's disease and (4) a miscellaneous group consisting of postphlebitic syndrome, trench foot and causalgia. Only those patients who had a postoperative follow-up are reported. Of a group of seventy patients sixty-one had sufficient follow-up to be evaluated.

There were thirteen patients with diabetes who had sympathectomies. Seven patients were between fifty-one and fifty-six years of age and six were between sixty-one and sixty-seven years of age. All were receiving insulin. Forty-six per cent of these patients had pain in their calf muscles at rest and one-half of these had relief of this symptom following sympathectomy. One-half of the patients had intermittent claudication and all had improvement following surgery. About 70 per cent of the group complained of cold feet before surgery and there appeared to be little improvement in this symptom following sympathectomy. Sweating was abolished postoperatively in all patients.

Eight patients had ulcers (duration eight weeks or less) and six of these had healing following sympathectomy. Six patients had gangrene of a digit and all had digital and metatarsal amputations with healing. One patient had osteomyelitis of a metatarsal with healing. One had a below-knee amputation following sympathectomy with satisfactory healing.

It was believed that sympathectomy had in the majority of these patients relieved claudication and aided in the healing of ulcers and of amputation sites. All but two of the patients thought that they had been improved.

Thirty-three patients with arteriosclerosis but without diabetes had sympathectomies and were followed up sufficiently long (six months to two years) to evaluate. Seventy per cent of this group had pain at rest and 74 per cent of these were relieved of this symptom following surgery. All but one patient had claudication as a preoperative symptom and 39 per cent had improvement and were able to walk farther before developing pain following sympathectomy.

Fifteen per cent of this group had amputations; two were below-knee and three were above-knee amputations. One occurred two years following sympathectomy and the others all occurred within four months. Fifty per cent of the patients had ulcerating lesions and one-half of these healed satisfactorily following surgery.

Nine patients with Buerger's disease had lumbar sympathectomies. The average duration of symptoms was from one to four years. All but two of the patients were between twenty-six and thirty-seven years of age. One patient, forty-eight years of age, had had symptoms for five years and one patient, fifty-six years of age, had had symptoms of eighteen years' duration.

Seven of this group (77 per cent) had rest pain and only one of these had improvement following surgery. Eighty-eight per cent or eight of this group had intermittent claudication and only two of these had improvement.

Four patients had ulcers on admission and three of these subsequently had a mid-thigh amputation; two of these were preceded by a below-knee amputation which failed to heal.

There were only six patients in the so-called "miscellaneous" group. Two of these had a postphlebitic syndrome. Both of them had had

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ulcers that were refractory to healing and both healed following sympathectomy. One patient had osteomyelitis of the left femur and an ulcer on the left foot. The osteomyelitis healed before surgery but the ulcer remained refractory; it healed following sympathectomy. Two patients had trench foot and the results in these two particular patients were not encouraging. One patient was operated on because of causalgia of the left foot and his pain was relieved following sympathectomy.

Four patients had femoral cutaneous neuritis and two had genitofemoral neuritis following surgery. All had recovery.

COMMENTS

Temperature recordings before and after sympathetic block (in some cases spinal anesthesia) were taken preoperatively in all cases. The average temperature rise was 2 to 4 degrees. Sympathetic block, however, may not give gratifying results in arteriosclerotic peripheral vascular disease where the vasotonic component may be quite minimal. The effect of an anesthetic block is short-lived and it has been quite well established that a maximum vasodilatory effect may not be demonstrated in some cases until the sympathetic pathway has been interrupted for a longer period of time. Freeman[1] states that sympathetic block does not allow sufficient time for blood vessels to dilate to their maximum capacity and this is shown by the fact that the rise in skin temperature following ganglionectomy exceeds the highest level obtained during block. Cole[2] reported good or excellent results following sympathectomy in six of seven patients with arteriosclerosis and diabetes; four of these patients had poor results following a sympathetic block.

In our series sympathectomy was avoided in patients who had a temperature drop following block. Freeman maintains that in advanced obliterative arterial disease, especially in patients without evidence of abnormal vasoconstriction, sympathectomy may result in gangrene. This is due to the fact that although the total circulation in the extremity may be increased after sympathectomy in these cases much of the blood is probably shunted directly into the veins through the opening-up of numerous arteriovenous anastomosis. The nutrient capillary flow may therefore be actually reduced. This phenomenon may be heralded preoperatively by a lowering of the skin temperature of the involved extremity following a lumbar block. Julian and Shabart,[3] however, do not hesitate to perform sympathectomy upon a patient who has a fall in temperature following lumbar block when that part of the extremity that sustained the temperature fall is amputated at the time of sympathectomy or shortly thereafter.

In this series of cases the patients with diabetes had the most favorable response to sympathectomy. In this group ulcers responded more favorably to healing and there was a greater degree of amelioration of symptoms than in the group characterized by arteriosclerosis without diabetes. DeBakey, Creech and Woodhall[4] divided their patients with arteriosclerotic peripheral vascular disease into two groups, namely, those with and those without diabetes. Among the patients with frank gangrene they were able to secure a viable, useful extremity in 25 per cent of the group without diabetes and in almost 50 per cent of the group with diabetes.

Gerber, McCune and Eastman[5] found no specific relationship between the results obtained following sympathectomy in those patients with arteriosclerosis and diabetes and in those with arteriosclerosis but without diabetes. Both groups responded equally well, only five amputations being necessary in the group of nineteen patients with gangrene of one extremity.

In Kirschmer's[6] series of fifty cases the patients with diabetes had twice as high a proportion of poor results as did those with arteriosclerosis. He believes that once tissue death has occurred the outlook for a good or fair result is slim and that subsequent major amputation is the ultimate form of therapy. The patients in this series, however, were in an admittedly poor physical condition suffering from malnutrition and avitaminosis. Kirschmer does not believe that sympathectomy lowers the site of amputation.

The group of patients in our series with Buerger's disease is small and our disappointing results are not confirmed by others. Campbell, Harris and Coller[7] followed up thirty-eight sympathectomized patients with thromboangiitis obliterans for two years. Fourteen patients had a good result, thirteen a fair result and eleven a poor result. The authors believe that if sympathectomy is to be effective, it should be per-

formed early in the disease. DeTakats[8] favors prophylactic sympathectomy in the uninvolved extremity in Buerger's disease.

Hamlin, Warren and Kennard[9] reviewed 180 cases of thromboangiitis obliterans seen at the Massachusetts General Hospital between 1926 and 1945. Since 1936 all the patients with this disease (eighty-five) have had lumbar sympathectomies, and of 170 sympathectomized legs 13.5 per cent were amputated. On the other hand, in a group of 190 non-sympathectomized extremities 35.2 per cent were amputated. They believed that the presence or absence of a palpable pulsating popliteal artery was of little significance in prognosticating the result of a sympathectomy; good and poor results appeared to be equally distributed. Kinmouth,[10] however, believes that better results are obtained following sympathectomy when the popliteal artery is palpable.

Many investigators believe that preamputation sympathectomy aids materially in the healing of stumps and also allows a lower amputation site. Lynn and Burt[11] believe that a below-knee amputation is more often obtained in a sympathectomized extremity. Lee, Krauskopf and Lilly[12] reviewed seventy-two cases of peripheral vascular disease and are of the opinion that lumbar sympathectomy was a definite factor in permitting below-knee amputations.

We do not believe that the use of vasodilator agents which produce generalized vasodilation is a rational therapeutic approach to the problem of enhancing the circulation in one or two extremities which suffer from an impaired and an inadequate blood supply. Their use is not recommended as an alternative for sympathectomy.

SUMMARY

A group of sixty-one patients undergoing lumbar sympathectomy was reviewed. The most favorable results were obtained in those patients who had arteriosclerosis with diabetes.

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DISEASES OF THE URACHUS*

WITH THREE ILLUSTRATIVE CASE REPORTS

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DISEASES of the urachus while not rare are uncommon. The first mention of urachal disease is generally accredited to Bartholomaeus Cabrolius[13] in 1550; while a second case is not found in medical literature until 1701 when Littre reported a case. In a review of the historical background of this vestigial organ Herbst in 1937 reveals that only three cases of urachal disease were reported in the eighteenth century, sixty-one in the nineteenth century and eighty-eight cases during the twentieth century up until 1937. Since that time numerous case reports have appeared in the literature, thus removing urachal disease from among the medical rarities. In any discussion of the urachus much credit must be given to Cullen whose clinical and exhaustive studies of the umbilicus and urachus published in 1916 leave little to be added even thirty-five years later.

Diseases of the urachus are usually classified with those of the genitourinary system; however, these cases are frequently first seen and treated by the general surgeon so that he should be familiar with the disease processes and their treatment.

EMBRYOLOGY

Considerable confusion still exists in the minds of many physicians between remnants of the omphalomesenteric (vitelline) duct and the urachus. The former is of course the fetal communication between the mid-gut and the yolk sac; the persistence of which leads most commonly to Meckel's diverticulum while the urachus represents the vestigial remnant of the allantois which in the fetus communicates with the cloaca. (Fig. 1.)

Concerning the minute details of the embryologic development of the urachus some controversy still exists. Cullen[8] was of the opinion that the allantois of the 5 mm. embryo communicates with the cloaca and by the 7 mm. stage the lower portion of the allantois is converted into the bladder, the upper portion developing into the urachus by the 12.5 mm. embryo stage. Begg[3] believes that the urachus is not a vestige of the allantois but is embryologically a portion of the bladder and that both the bladder and urachus develop from the ventral cloaca as a single hollow viscus. Following birth the bladder and urachus begin a descent which continues until the bladder reaches the adult position in the pelvis. The urachus in the adult extends from the umbilicus to a point one-half way between the umbilicus and symphysis pubis. During the descent the urachus pulls along its attachments to remnants of the umbilical arteries and the umbilical cord. (Fig. 2.) The latter process inverts the umbilicus. The urachus is lined by transitional epithelium and is believed to remain patent[3] throughout life although it may become plugged by epithelial cells. According to Begg's findings the lumen of the urachus is separated from the bladder itself by an interposed partition of thin mucous membrane in approximately two of three individuals, while one person of three fails to develop such a partition. Increased intravesical pressure produced by phimosis, congenital urethral valves, prostatic hypertrophy or stricture may result in the acquired type of urachal cyst in this latter group of individuals.

CLASSIFICATION

The most frequent cause of urachal disorder is a developmental disturbance of obliteration. This may involve the entire structure in which case a patent tube exists between the umbilicus and the dome of the bladder with drainage of urine from the umbilicus, or it may be a partial persistence resulting in cyst formation when both ends are closed, or blind cysts communicating with either the umbilicus or bladder. In most instances these embryologic defects cause little or no trouble as long as they remain free from infection; however, when infection inter-

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venes (frequently in adult life as illustrated by our two cases, age fifty-three and thirty-two) surgical intervention is usually necessary. In the closed cyst the accumulation of secretion may lead to an increase in size sufficient to cause symptoms even in the absence of infection.

own. The following year Higgins reported two cases and Rappaport and Nixon another case. Cawker contributed one case and Prentiss three cases in 1947. In 1950 Loeb reported one case as did Bandler and Roen. Hurwitz, Jacobson and Ottenstein presented two cases in 1951.

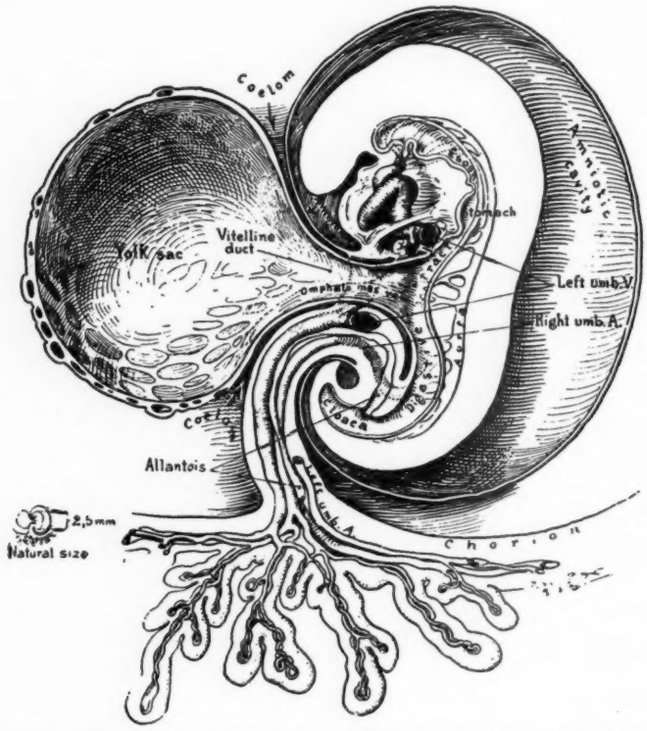

FIG. 1. Drawing of a 2.5 mm. embryo showing allantois, cloaca and associated structures. (Courtesy of W. B. Saunders Co.)

Infection of the urachus may occur from the bladder in which case the organisms will be those customarily associated with urinary tract infection; or if there is a communication at the umbilicus, any contaminants from that area may reach the urachal sac. One case of actinomycosis[18] and two cases of tuberculous involvement of the urachus have been reported.[9,17] The usual urachal infection is in the nature of an acute abscess necessitating incision and drainage; however, as illustrated by our second case a chronic, low grade process producing a large, solid granulomatous mass may occur which closely resembles neoplasm on gross examination.

Carcinoma of the urachus continues to be a rare disease with approximately 80 per cent of the cases being reported in men. Hayes and Segal in 1945 after reviewing the literature reported forty-five cases including one of their

The undifferentiated lining of the embryonic cloaca has the potential to form enteric or urinary (urachal) epithelium after the cloaca has separated into vesical and intestinal portions. The lining of the urachus is an irregular form of transitional stratified epithelium and, as Willis states, may give rise to gland-like growths from which carcinomas and benign cystic growths may develop. The former most frequently is mucoid adenocarcinoma and may be difficult to differentiate from mucoid adenocarcinoma arising from the bladder. Epidermoid carcinoma may also arise in the urachus. According to Anderson adenomas and mucoid adenocarcinomas are the most common urachal neoplasms.

Shaw reviewed the literature and found five reported cases of sarcoma of the urachus and added one of his own. He presents criteria for diagnosis of sarcoma and further states that it

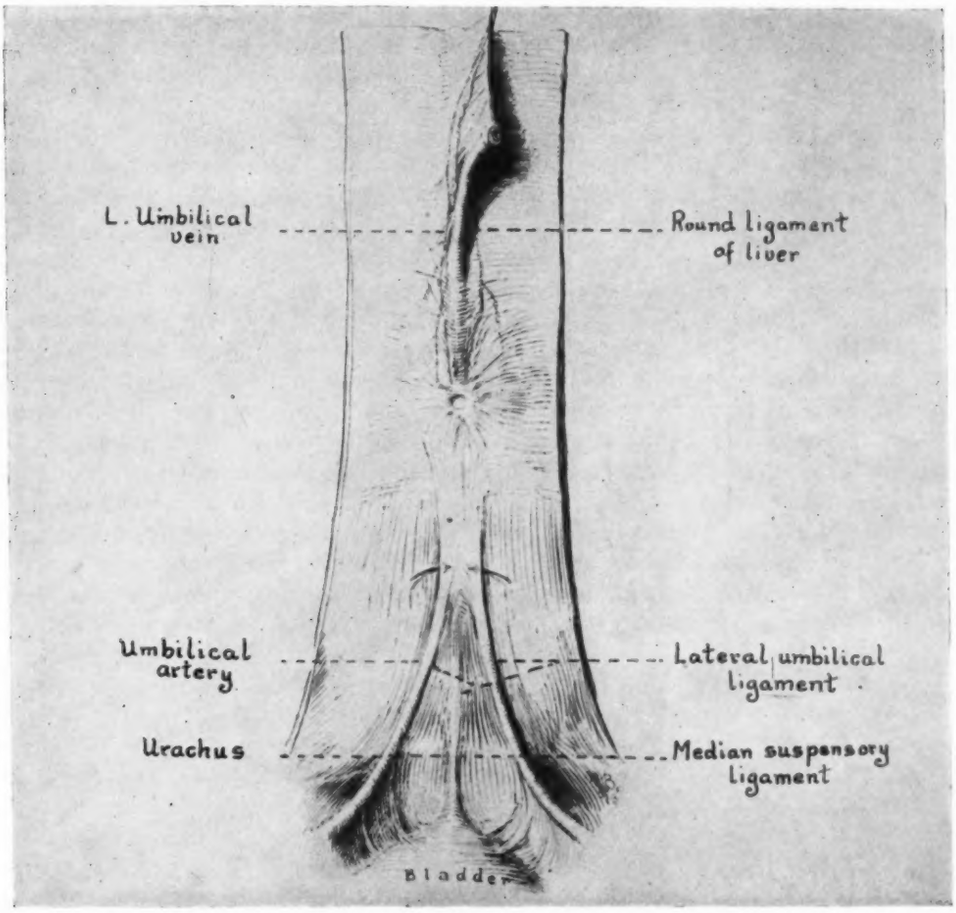

FIG. 2. Internal view of anterior abdominal wall showing fetal and adult structures. (Courtesy of W. B. Saunders Co.)

is doubtful if a completely substantiated case has yet been reported. (Table 1.)

DIAGNOSIS AND TREATMENT

The history of persistent drainage from the umbilicus and/or the presence of a mass about the umbilicus or between the umbilicus and symphysis pubis strongly suggest urachal disorder. Chronic omphalitis or omphalomesenteric duct remnants are the two conditions most likely to be confusing. In those cases in which an open communication exists between the bladder and umbilicus, dye such as methylene blue may be given by mouth and observed to emerge at the umbilicus, or it may be injected at the umbilicus and observed in the urine. A large urachal cyst or tumor may produce an indentation of the dome of the bladder as demonstrated by cystography. Cystoscopy may be of help in demonstrating a meatus in the apex of the bladder or in the case of urachal tumor actual visualization and biopsy of invading neoplastic tissue may be possible. The conclusion of Begg that a potential free communication exists between the bladder and urachus in one of three individuals is not well supported by clinical fact since we see so many cases of bladder neck obstruction without an acquired urachal cyst. However, it is well to rule out the presence of urinary obstruction by such conditions as phimosis, urethral strictures, congenital urethral valves, prostatic hypertrophy, vesical stone or tumor.

The urachus being a redundant organ is best treated by surgical extirpation when it becomes diseased. In the presence of acute infection simple incision and drainage is of course the first stage of treatment to be followed with surgical excision when the infection has subsided. Although the urachus lies in a properitoneal position, its removal following infection is rarely possible without entering the peritoneal cavity. The present use of antibacterial agents has markedly reduced the hazard of

peritonitis formerly associated with surgical procedures on this organ.

Sacrifice of the umbilicus may or may not be necessary, although sentimental attachments indicate that it be spared whenever possible especially in children. The bladder end of the urachus may be inverted by purse-string suture or preferably a cuff of bladder may be excised.

In the case of malignant involvement radical excision including the umbilicus, a large portion of the bladder and a wide block of intervening tissue is necessary. Sacrifice of a large portion of the anterior parietal peritoneum offers no great problem as frequently demonstrated in radical cancer surgery.

We wish to report three illustrative cases, the first representing an infected persistent urachus open at the umbilicus, the second an example of a urachal cyst with chronic, low grade infection producing a solid, firm mass and the third an adenocarcinoma of the urachus involving the bladder.

CASE REPORTS

CASE 1. *Acutely infected urachal cyst:* C. B. S., a thirty-two year old white man, was admitted to the hospital on October 29, 1950, complaining of pain around the umbilicus for a period of one week. A local physician had probed the umbilical area a few days previously and extracted multiple, long coarse hairs approximately 3 to 4 cm. in length, followed by drainage of foul-smelling pus. The patient was referred to this hospital for further treatment. Past history was not contributory.

Physical examination revealed a well developed, white man with no abnormality except for an area of reddening and tenderness about the umbilicus approximately 3 to 4 cm. in diameter. Pressure about this area resulted in a drainage of pus into the umbilicus. X-rays of

TABLE 1

Pathologic Entity	Clinical Entity
A. Developmental	
1. Non-formation of urachus:	
(a) Arrested development before closure of ventral cloaca	(a) Exstrophy of bladder
(b) Arrested development after closure of cloaca	(b) Persistent fetal bladder (usually associated with umbilical urinary fistula)
2. Arrested formation of urachus (abnormal descent rarely co-exists)	2. Persistent urachus, narrowed upper segment of fetal bladder, segmental narrowing of urachus with closure of either or both ends resulting in various size and types of cysts
3. Abnormal descent of urachus (may occur in presence of either normally developed urachus or any degree of arrested formation)	3. a, b, c, d—same as A2
(a) Failure to descend	
(b) Incomplete descent	
(c) Deviation from midline due to unequal lateral attachments	
(d) Laceration of urachus	
(e) Deposition of nests of epithelial cells torn from urachus during this process	(e) Possible cyst formation and malignant change
B. Infectious	
1. Infected urachal remnants	1. Abscesses of urachus, infected cysts, granulomas, tuberculosis of urachus secondary to tuberculosis of bladder and actinomycosis associated with a similar bladder infection
C. Metabolic	
1. Urachal calculi	1. Urinary calculus formation in a patent urachus
D. Neoplastic	
1. Benign tumors	1. Adenomas, cysts
2. Carcinoma	2. Adenocarcinoma, epidermoid carcinoma, colloid carcinoma, mucoid carcinoma
3. Sarcoma?	3. Positive primary involvement of urachus is questionable

the chest and abdomen were normal. Other laboratory examinations on admittance included a negative serology, a white blood count of 14,850, hemoglobin 16 gm. per cent. Urinalysis was negative. The patient was placed on continuous hot packs to the inflammatory area and antibiotic therapy was started. A cystogram accomplished on October 31st was not remarkable. A cystoscopy examination on November 1, 1950, was normal. On November 16, 1950, the patient was taken to surgery where under sodium pentothal® anesthesia, an incision and drainage of the fluctuant area 2 cm. below the umbilicus was accomplished. A copious quantity of pus was drained and the wound was packed open. Antibiotic therapy was continued and the open wound was irrigated intermittently with azochloramide solution. The culture revealed Bacillus proteus and staphylococcus. The drainage gradually subsided and by December 4th a minimal amount of drainage was present. On December 29th the patient was again taken to surgery where under spinal anesthesia the umbilicus and scar of the previous incision as well as the underlying fibrotic area were excised. The urachus was traced to its point of attachment to the dome of the bladder and was ligated and divided. A portion of the obliterated umbilical arteries on either side of the urachus was involved in the inflammatory reaction and was removed. The patient's postoperative course was uneventful and he was discharged from the hospital eight days following surgery. The pathologic report was persistent urachus with chronic inflammation.

Case 11. *Chronic granulomatous cyst of urachus:* A. H. G., a fifty-three year old white man, was admitted to the hospital on January 9, 1950, complaining of pain in the lower abdomen. He stated that approximately three months prior to admission he noticed an intermittent cramping pain in the lower abdomen localized over the symphysis pubis. Pains were at first mild but gradually increased in severity. There was no history of bladder disturbance, hematuria or urinary frequency. Anorexia had developed and the patient lost 11 pounds during the three months prior to admission. There was no history of bowel disturbance. One week prior to admission the patient saw his local physician who cystoscoped him and told the patient he had a bladder tumor, referring him to this hospital for further treatment. Past history was non-contributory.

Physical examination on admission revealed a well developed white man who did not appear acutely or chronically ill. Positive physical findings were limited to the abdomen. There was a well healed right lower quadrant scar, residuals of a previous appendectomy and bilateral herniorrhaphy scars. There was a palpable mass in the lower abdomen extending in the midline from the symphysis to about 1 inch below the umbilicus. The mass was noted to be some 2½ to 3 inches in width. It appeared to be superficial in location and was extremely hard and non-movable as well as moderately tender on attempted manipulation.

Laboratory findings revealed a negative serology, white blood count of 15,100 and hemoglobin 12.5 gm. per cent. Urinalysis was negative except for a rare white blood count and epithelial cells. The blood chemistry findings were essentially within the limits of normal. Kidney-ureter-bladder x-ray, intravenous urography from the ten to the twenty-minute interval and retrograde cystogram were normal. Barium enema failed to reveal any significant abnormalities. A definite diagnosis could not be made on the patient and on January 17th he was taken to surgery where an abdominal laparotomy was accomplished under spinal anesthesia. A midline incision was made from the umbilicus to the pubis, the recti muscles were separated. A firm nodular tumor mass could be felt to occupy a position anterior to the peritoneum. The peritoneum was opened laterally, the sigmoid colon and the dome of the bladder were firmly adherent to the tumor mass. The bladder was opened anteriorly and the entire dome of the bladder containing the tumor was removed. The bladder was closed using an indwelling catheter through the suprapubic area. A portion of the sigmoid involved in the tumor was then exteriorized through a left lateral McBurney type of incision. On pathologic examination the specimen proved to be a urachal cyst with acute and chronic inflammation, abscess formation and fibrous peritoneal adhesions to the sigmoid colon. There was reactive hyperplasia of the regional lymph nodes. Postoperatively the suprapubic wound closed spontaneously and the colostomy was closed one month following. The postoperative course was quite smooth and the patient

was discharged from the hospital asymptomatic on March 2, 1950, and has remained well.

CASE III. *Adenocarcinoma of urachus:* E. E. L., a fifty-nine year old man, was admitted to the hospital on June 20, 1951, complaining of blood in his urine and burning on urination of nine months' duration. In March, 1951, the patient was operated upon at a local hospital where a suprapubic cystotomy was accomplished, the patient being told that he had an inoperable carcinoma. The surgical biopsy showed an adenocarcinoma involving the urinary bladder, possibly primary in the urachus. Since the original surgical procedure the patient continued to have some blood in the urine and occasional dysuria. Past history revealed a history of cerebral thrombosis in 1945 with a transitory right hemiplegia.

Physical examination revealed an apparently chronically ill patient with a well healed suprapubic operative scar. No abdominal masses were palpated. There was tenderness to palpation in the left hip region.

X-rays of the chest and pelvis revealed no bony change. White blood count was 16,100 with normal differential. Other laboratory findings were within the limits of normal. A cystogram revealed a contracted bladder that was grossly irregular and appeared to be elevated by a mass. A small papillary mass in the dome of the bladder was seen at cystoscopy. A biopsy was reported as an adenocarcinoma involving the urinary bladder, possibly primary within the urachus. On July 10th the patient was taken to surgery where an abdominal laparotomy was accomplished. The main tumor appeared to be in the dome of the bladder with the sigmoid colon adherent to the left lateral portion of the bladder and also adherent to the abdominal wall. Nodules were present in the mesentery. The bladder was opened anteriorly and the tumor was excised with a fairly wide cuff. The bladder was closed around a suprapubic drainage catheter. Pathologic diagnosis was adenocarcinoma with the probable site of origin in the urachus. Numerous sections were taken showing the presence of normal urachus adjacent to adenocarcinoma, however, the site of transition between normal urachus and tumor was not demonstrated. The patient's postoperative course was uneventful. Following wound healing the patient received a course of deep x-ray therapy.

SUMMARY

1. The historical background and embryologic development of the urachus and its diseases are reviewed.

2. A classification based on a review of the literature of diseases of the urachus with correlation between the pathologic and clinical entities is presented along with comments on diagnosis and treatment.

3. Case summaries of an acutely infected urachal cyst, a chronic infected granulomatous cyst and an adenocarcinoma of the urachus are reported.

CONCLUSION

Benign diseases and malignant degeneration of the urachus are rare. The general surgeon should be acquainted with these pathologic entities as he frequently is the first to see and treat such patients.

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For the past twenty years at the Massachusetts General Hospital about all of the patients with ulcerative colitis eventually underwent ileostomy with or without subsequent partial or total colectomy. Recently some patients have been sufficiently relieved by ACTH so that surgery can be postponed. Ultimate results of ACTH therapy are as yet unknown, however. Banthine has also proven helpful in these patients according to reports from other medical centers. (*Richard A. Leonardo, M.D.*)

POSTMORTEM CESAREAN SECTION

SURGICAL AND LEGAL ASPECTS

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THE opportunity to perform a postmortem cesarean section and to obtain a living child is offered to only a few physicians. A review of the literature reveals that only twenty-two successful postmortem cesarean sections were reported in the entire world from 1937 to 1950. Only ten of this number were in the United States. The states reporting were Texas, Nebraska, Utah, Colorado, Missouri, Massachusetts, West Virginia and the District of Columbia. The more recent cases to be reported were two by Simmons and Ellis in March, 1949; both patients in these cases died of bulbar poliomyelitis and living infants were obtained. Kronick reported a successful postmortem section following death from pulmonary tuberculosis in December, 1950.

Postmortem cesarean section is the oldest known major surgical operation. The Roman senate decreed in the year 715 B.C. that no woman advanced in pregnancy would be placed in the sepulchre until the child had been removed from her body by this operation. In the year 1749 the King of Sicily passed the sentence of death upon a physician who failed to perform the operation upon a woman who died in the last month of pregnancy. There are laws in the Talmud and of the Roman Catholic Church making this imperative.

CASE REPORTS

CASE I. Mrs. L. C., No. 107809, a twenty-one year old white primigravida, was admitted to Lakeview Hospital at 10:40 A.M. on December 11, 1948. She sustained a head injury in an automobile accident about an hour previous to admission. Her last menstrual period had occurred May 2, 1947, and the estimated date of confinement was February 9, 1949. Prenatal course had been uneventful. The nurse who accompanied her from the ambulance entrance to the surgical floor stated that the patient stopped breathing on the elevator enroute to the emergency room.

Physical examination of the patient revealed no respiratory movements, no pulse and an occasional faint heart beat. There was blood stains over the face and head. Examination of the abdomen revealed the uterus enlarged to the size of a seven months' pregnancy. Artificial respiration with an oxygen bag on the McKesson machine was started. At 10:52 A.M. the patient's heart beat was no longer audible and an incision was made through the abdominal wall and uterus. A premature male infant weighing 4 pounds, 4 ounces was removed. The infant was resuscitated with an intratracheal catheter and placed in an incubator.

An autopsy performed on the mother revealed a skull fracture and massive intracranial hemorrhage. The infant expired eight hours later; autopsy was not done.

CASE II. Mrs. B. W., No. 2586, a thirty-three year old white, gravida II, para I was admitted to St. Elizabeth's Hospital, Danville, Illinois, in convulsions at 3:50 P.M. on May 27, 1951. Her other pregnancy seven years previous was uneventful. Her last menstrual period occurred September 10, 1950, and her estimated date of confinement was June 17, 1951. She had seen her family physician only once, two months previously.

The patient's husband called the family physician at 2:30 P.M. because the patient suddenly began having convulsions. An ambulance was called and the patient was taken to the hospital. She had two more convulsions enroute to the hospital and another one following admission. Following the last convulsion the patient remained in a coma and was cyanotic.

On examination at 4:10 P.M. she had a bloody frothy discharge from the nose and mouth. There was generalized pitting more marked over the lower extremities. The pulse was slow and the nurse had recorded the patient's blood pressure as 180/110. Examination of the abdomen revealed a near term pregnancy with the fetus in the vertex position. Fetal heart

tones were audible in the right lower abdomen. The patient was given atropine sulfate gr. 1/150 and oxygen was started. A catheterized urine specimen showed four plus albumin and numerous hyaline and granular casts. Patient ceased breathing and her pulse became imperceptible at 4:40 P.M. Permission to perform a postmortem section was refused by her husband. The Sister Superior of the hospital was summoned, and she returned with the surgical supervisor and an emergency surgery set. The Superior requested that a postmortem section be done. At 5:10 P.M. an incision was made through the abdomen and uterus and a severely asphyxiated female infant weighing 6 pounds, 2 ounces was removed (twenty-three minutes following death of the mother). A large quantity of amniotic fluid was drained and aspirated from the infant's mouth, nose and trachea. Stimulants were given and artificial respiration with an intratracheal catheter was continued for thirty-five minutes. The baby finally began having jerky, irregular respiratory movements. She was placed in an incubator, but continued to have periods of cyanosis and expired thirty-six hours later. An autopsy on the mother and baby was refused by the husband.

COMMENT

Critical examination of these operations brings forth a number of practical points for consideration. First, during what period of gestation can we hope to obtain a living child after its mother's death? The answer to this is the same as for the viability of any infant born at the same period of gestation, and it has been set by various authorities at from the twenty-sixth to the twenty-eighth week. Second, how long after the death of the mother can the fetus survive *in utero*? Linzenmeier concluded that twenty minutes was the greatest length of time after death that a living child could be obtained, and Bacon reported that there was no authentic case on record in which the child lived more than twenty-five minutes after maternal death. Precisely when death occurs is difficult to determine. If possible have a consultant present to help decide the exact moment of death.

The fetal prognosis is better in sudden rapid death of the mother than after long-continued infectious diseases, intoxications, malignancies or diseases of the blood. In reviewing the literature the principal causes of death of the mothers were nephritis, eclampsia, heart disease, cerebral hemorrhage, bulbar poliomyelitis and trauma.

Since time is an important factor the physician is not justified in searching long for signs of fetal life. If the fetal heart has been heard or fetal movements felt just before death of the mother, it is reasonable to assume that the fetus is still living and the physician should proceed to immediate delivery. Experience has shown that postmortem delivery from below (except when the cervix is fully dilated and the head lies low in the pelvis) has usually resulted in the death of the infant.

When performing a postmortem section, the same aseptic technic should be maintained as is used in an ordinary abdominal operation. If this is not possible, with any sharp instrument at hand, the abdominal wall and fundus should be incised and the infant removed. The placenta should be removed so that it will not be forced into the vagina later by uterine contractions. The uterus and abdomen should be sutured because history relates more than one instance in which an incision was made into the abdomen of a supposedly dead woman for the purpose of removing her child, and subsequently it was shown that she was still alive.

Medicolegally very little can be said with any degree of assurance for the principles of law applicable are none too clear. It is not certain what crime, if any, a physician commits if after the death of the mother to be, he fails to perform a postmortem section to save the infant in the event that it dies as a result of that failure. An unborn viable child is capable of independent existence and should be regarded as a separate identity. If the laws recognize an unborn child sufficiently to protect its property rights and rights of inheritance and protects it against the claims of others, the law should recognize the unborn child's separate existence for the purpose of redressing wrongs.

How far, if at all, the refusal of the father of the infant to consent to the operation would relieve the physician of criminal and civil liability, if there is any, is an open question. There is little doubt as to how public opinion would regard both the father of the unborn child and the physician who might by operation have saved the life of the child if they, singly or together, by inaction killed it. The only action the father could bring would be based on the mutilation of the body of his deceased wife, for certainly he could not claim

to be damaged by having the life of his child saved. This question has been before the Bureau of Legal Medicine of the American Medical Association on previous occasions, but there have been no recent discussions on the medicolegal aspects of it. A report of two cases in which such operations were performed appeared in the Boston Medical and Surgical Journal for November 11, 1926. In connection with this report there appeared references to a discussion of a paper presented by C. S. Bacon at a meeting of the Chicago Gynecological Society in December, 1910, relative to the "Legal Aspects of Postmortem Cesarean Section." In neither of these discussions was the subject very thoroughly presented. In only one state, Oklahoma, has any legislation been enacted dealing with this matter. In 1943 a law was passed in that state declaring it to be lawful for a physician to perform a postmortem section, in the absence of protest by those in whom the law has recognized a legal right to the body of the deceased woman. As this law is interpreted it only enables the physician to use his own professional judgment about the matter in the absence of specific objection on the part of those entitled to the legal possession of the body. Just what the law accomplishes is a matter of considerable doubt.

No individual has the right to deliberately and intentionally take the life of another or to deprive another of the right to live. The obligation to save the human fetal life when it can be done without destroying or jeopardizing another life is absolute. It is generally believed that no court today would hold that a father has the right to choose death for an unborn viable child by withholding his consent for a postmortem section. Although there is no analogous decision by an appellate court of last resort, the conclusion is borne out by the case which recently received substantial newspaper publicity wherein a Chicago trial court ordered a newborn infant with erythroblastosis to be transfused in order to save its life in spite of the active objections of the parents. Common sense, Christian morals and natural justice force us to this conclusion and it is this opinion that any court of today would so hold.

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CHRONIC APPENDICITIS OR PAINFUL OVARY?

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BECAUSE patients who consult gynecologists for pain in the right lower quadrant of the abdomen frequently give a history of previous appendectomy for chronic appendicitis, it seemed that a study of this problem would be of interest. Accordingly two groups of cases were studied. The first group comprised 100 consecutive appendectomies for chronic appendicitis from the records of the Pittsburgh Hospital; this will be group I. Group II consisted of all the author's office patients for several months who gave a history of appendectomy for chronic appendicitis.

Group I. Of the 100 cases of chronic appendicitis, ninety-nine were diagnosed chronic appendicitis on dismissal from the hospital and one was diagnosed acute ulcerative appendicitis on the basis of microscopic examination by the pathologist. Twenty-three of the 100 patients had a provisional diagnosis of acute appendicitis and seventy-seven chronic appendicitis. The twenty-three cases were included because the history, physical examination and laboratory findings were not those of acute appendicitis but of chronic appendicitis and were so summarized by the physician who wrote the history. In many of these patients the symptoms had been present for weeks or months. Twenty-two patients were men and seventy-eight women. The age distribution of the women is shown in Figure 1. The majority were between eleven and twenty-five years.

The only two consistent findings (Table I) were the presence of pain in the right lower quadrant of the abdomen and tenderness to palpation of this area. Neither of these can be said to be pathognomonic of chronic appendicitis. Nausea occurred quite often, in seventy-two cases; but vomiting was relatively infrequent, twenty-seven cases. Twenty-nine patients had an elevated leukocyte count to 10,000 per cu. mm. blood. Only six patients showed any fever. Pyuria of significant amount (numerous WBC/HPF) was found both preoperatively and postoperatively in twenty-eight cases. Most of the patients had been observed by the family physician or the surgeon for months before the appendectomy was undertaken as a precautionary measure when no other cause for the symptoms could be found.

Table II demonstrates that we need not fear acute pathologic disorder in cases labeled

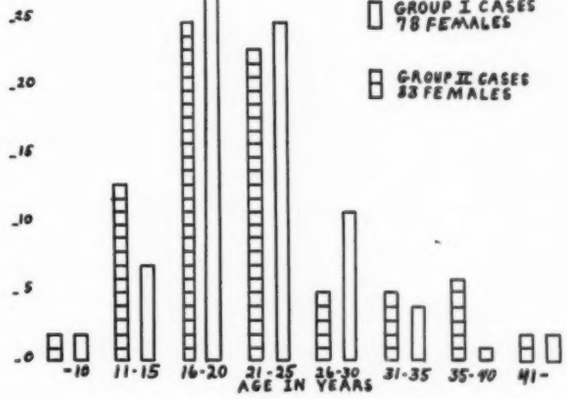

FIG. 1.

chronic appendicitis. Of the 100 cases, ninety-nine were reported as chronic appendicitis by the pathologist. This is minimal disease, if any. One case was described as chronic appendicitis grossly but as acute ulcerative appendicitis when the microscopic sections were viewed. The operating surgeon called twenty-one of the 100 cases acute at the time of operation. However the diagnosis was usually modified by the term mild or by a qualifying description such as subserosal injection. No appendix was described as acutely infected.

Group II. These patients fell into three main groups. (Table III.) The first group, had pain in the right lower quadrant of the abdomen as a chief complaint. The second, group B, complained of menorrhagia or irregular menses. The third, group C, were seen for a variety of reasons which included pregnancy, infertility, incontinence and pruritus. All groups had one thing in common. Each patient had had her appendix removed for what she described as "chronic appendicitis" from one to

twenty-eight years previously. The forty-nine cases in group A (Table III) comprise 59 per cent of the entire eight-three cases in group II. Of these, twenty-four were seen five years or less following appendectomy. Thus nearly 50 per cent of the patients with pain sought medical advice within five years of the operation performed because of a similar pain.

TABLE I
SYMPTONS, SIGNS AND LABORATORY DATA

Abdominal pain—right lower quadrant	100
Abdominal tenderness—right lower quadrant	98
Nausea	72
Abdominal pain—generalized	39
Leukocytes 10,000 or more/cu. mm. blood	29
Pyuria (numerous WBC/HPF)	28
Female	27, dysuria 3
Male	1
Vomiting	27
Fever 100°F or more orally	6

TABLE II
CORRELATION OF APPENDICITIS DIAGNOSIS

At Admission	At Operation	In Laboratory	At Dismissal
Acute, 23	Acute, 15 Chronic, 8	Chronic, 23	Chronic, 23
Chronic, 77	Chronic, 71	Chronic, 70 Acute, 1	Chronic, 70 Acute, 1
	Acute, 6	Chronic, 6	Chronic, 6

TABLE III
SUBSEQUENT COURSE OF EIGHTY-THREE APPENDECTOMIZED PATIENTS

(A) Abdominal pain—right lower quadrant (two had oophorectomy with appendectomy)	49
(B) Menorrhagia—no pain (two had oophorectomy with appendectomy)	17
(C) Infertility, pregnancy—no pain (two had oophorectomy with appendectomy)	17

The age of the patients at the time of appendectomy is compared with that of the women of group I in Figure 1. Both groups are essentially the same and show that the great majority of women are operated upon for chronic appendicitis between the ages of eleven and twenty-five, inclusive. Coincidently, these are the years of greatest activity in the ovaries.

The seventeen cases in group B (Table III) had menorrhagia or irregular menses. The chief cause for such disturbances is ovarian dysfunction. If we assume that the pain of "chronic appendicitis" is frequently due to a malfunctioning ovary, we would expect to find many patients continuing with abdominal pain and menorrhagia following appendectomy. This is confirmed by the large number of cases in groups A and B which total 66 or 79.5 per cent of the eighty-three appendectomized patients.

TABLE IV
PELVIC FINDINGS IN EIGHTY-THREE APPENDECTOMIZED PATIENTS

	(A) Pain Group	(B) Menorrhagia Group	(C) Miscellaneous Group
Cystic ovary	18	4	1
Tender ovary	10	2	0
Early pregnancy	4	3	9
No pelvic findings (menorrhagia)	10	6	0
Pyelitis	2	0	0
Other	5	2	7
	49	17	17

Analysis of the pelvic findings in groups A and B (Table IV) further confirms that the ovary is at fault in nearly all cases. There cannot be any quarrel that a cystic or tender ovary can cause pain in the lower abdomen. Early pregnancy can also cause such pain because of ovarian enlargement. A tender and/or cystic ovary is often the cause of menorrhagia, but the latter may occur from ovarian dysfunction when there is no palpable pelvic evidence of trouble in either ovary. It is for this reason that menorrhagia, in the absence of pelvic findings, is considered evidence of ovarian dysfunction. Only nine patients of the sixty-six in groups A and B had non-ovarian causes for the abdominal pain or menorrhagia. Any doubt as to the validity of this claim is removed by noting the result of treatment. All patients with ovarian dysfunction as the etiologic factor in their complaints, or fifty-seven of the sixty-six patients, were treated with 5.0 mg. daily doses of diethylstilbestrol, usually for twenty days as described originally by Karnaky.[1] The results were successful in all cases. Two previous studies on the use of diethylstilbestrol in functional ovarian disorders[2,3] have shown that the results, although excellent, are not quite 100 per cent.

COMMENT

The fact that 78 per cent of the patients operated upon for chronic appendicitis were women suggests the possibility that the sexual organs might be involved in the symptom complex. Since the right ovary is in close proximity to the appendix this possibility becomes more likely.

When 59 per cent of the women who have had appendectomy for chronic right lower quadrant abdominal pain subsequently seek medical care for recurrence of right lower quadrant pain, the appendix was not the cause of that pain.

If 79.5 per cent of the women who have had appendectomy for chronic right lower quadrant pain subsequently return with ovarian pain or other evidence of ovarian dysfunction such as menorrhagia, it is not unlikely that ovarian dysfunction could have been the cause of the original pain.

The ovarian pain of Mittelschmertz has long been recognized. What is not so well known is that poorly functioning ovaries are often painful. This can be demonstrated by palpating such ovaries in a bimanual examination and reproducing the pain. Stilbestrol or other high dosage estrogen therapy will relieve such pain and tenderness of the ovaries.

The gross and microscopic findings in apendices removed from patients diagnosed as having chronic appendicitis do not differ from those in appendices removed incidental to other abdominal surgery.

SUMMARY AND CONCLUSIONS

1. A group of 100 patients operated upon for chronic appendicitis are analyzed as to age, sex, symptoms, signs and pathologic disorder.

2. A group of eighty-three women who had appendectomies for chronic appendicitis are analyzed as to subsequent complaints and the cause for these complaints.

3. It is noted that 78 per cent of cases of chronic appendicitis occur in women.

4. Of the cases of chronic appendicitis in women, 78 per cent occur between the ages of eleven and twenty-five; the same years that the ovaries are establishing their cyclical activity.

5. Of the women appendectomized for "chronic appendicitis" 79.5 per cent return with signs and symptoms of ovarian dysfunction; 74.2 per cent of these have pain in the right lower quadrant of the abdomen.

6. It is suggested that right lower quadrant pain attributed to chronic appendicitis in women is frequently due to a painful, tender ovary.

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Obstetric Clinic

THE woman about to become a mother or with a new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly or selfishly.

OLIVER WENDELL HOLMES

10th of the Series

ABORTION*

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MORTALITY from abortion is decreasing in line with decrease in maternal mortality from other causes. Examination of case reports, however, indicates that good management of controllable factors should reduce deaths from abortion to a far lower level.

CASE I. A physician was called to the home of a thirty-nine year old white woman because of fever; her temperature was 102°F. The patient failed to disclose that she had had three months of amenorrhea followed by vaginal bleeding. No pelvic examination was performed. She was given medication for a supposed virus infection.

On arrival at her home the following day the physician found her in deep shock from vaginal hemorrhage. He administered caffeine and adrenalin and summoned an ambulance. The patient died five minutes after admission to the hospital.

Autopsy showed a large, soft uterus with a piece of necrotic placental tissue about 4 cm. long attached to the posterior wall of the uterus. The cervix was widely dilated. The other pathologic findings were those of acute anemia.

CASE II. The patient was a thirty-six year old Negro multipara who had had no prenatal care. Vaginal bleeding which had been going on for three days became profuse shortly before admission to the hospital. On examination she was pulseless, cold, clammy, semiconscious and dyspneic. At this time she expelled an eighteen-week fetus, but the placenta was retained and bleeding continued. The placenta was removed with an ovum forceps and the uterus and vagina packed with gauze.

Treatment included the administration of intravenous glucose and saline solutions, stimulation and Trendelenburg position. The patient died four hours after admission while blood for transfusion was being awaited. After death added history indicated that she had induced abortion upon herself with a catheter.

* Cases are from the Committee on Maternal Welfare of the Medical Society of the County of Kings, Brooklyn, N. Y. The text of the case reports is essentially as submitted to the Committee. The views expressed are those of the authors.

Questions. (1) What is the incidence of abortion? (2) What is the mortality of abortion? What part does abortion play in the total maternal mortality? Is it any higher for the Negro? (3) What are the causes for death? Can hemorrhage from abortion cause death? (4) Is morbidity an important problem? (5) In the treatment of incomplete non-septic abortion what is the best time for the removal of retained tissue?

Answers. It is likely that at least 10 per cent of all pregnancies are terminated by abortion. The relative frequency of abortions to full term confinements can generally be obtained readily, for women are apt to be truthful about previous abortions when relating past histories, indicating that in cities the ratio of abortions to confinements varies from 1:3 to 1:5. In rural areas abortion apparently occurs less often.

In large city hospitals abortions often constitute the most common single cause for admission to the obstetric service and represent about 25 per cent of all admissions. This is true at the Kings County Hospital in Brooklyn, to which about 800 patients with abortion are admitted every year.

To estimate the total incidence of abortion one must add those instances in which abortion occurs spontaneously without the patient's knowledge. For the most part these abortions occur at the time of a menstrual period. The mortality associated with abortion is at least as difficult to determine as the incidence. In hospital practice it is estimated to be about 0.1 to 1.0 per cent.

Until 1948 deaths associated with abortion were assigned to non-puerperal causes if a joint cause of death took precedence in official tabulations. Errors also occurred when death was reported as due to a puerperal cause but without mention of the period of gestation or to septicemia or peritonitis without any mention of pregnancy, or both. Inaccuracies in death certificates play a part in concealing the true high incidence of death from abortion. Information on the death certificate may be omitted intentionally, or the fact of abortion may have been denied by the patient unknown to the physician or not thought to be pertinent since septic complication may not be pelvic or may not result in death for months. Nevertheless, analysis of causes for total maternal mortality in large cities has shown abortion to be responsible for about 20 per cent.

It is clear that mortality from abortion is greatly higher in the Negro. For the United States during the period 1933 to 1945 it has been estimated as four times as high. In the city of New York, the only place in the United States where the fact of abortion is reportable, mortality from abortion in the non-white races is considerably higher.

Death from abortion is generally due to sepsis. Generalized suppurative peritonitis and septicemia with septic pelvic thrombophlebitis and embolic dissemination to the lungs are common autopsy findings. Perforation of the uterus is not infrequent. That hemorrhage can cause death from abortion has been shown. It is the principal cause of death in the non-septic cases, usually occurring in abortion of twelve weeks or more when the greater area of placentation and increase in the number and size of blood vessels account for the profuse hemorrhage.

The morbidity of abortion is important, yet it is impossible to discuss it statistically. Post abortal infection is a prominent cause of chronic pelvic inflammatory disease with its long-standing pelvic discomfort, disability and exacerbations which may require repeated hospitalization. Ultimately hazardous major surgery may be indicated to cure the patient. Abortion is a factor in the etiology of ectopic pregnancy and sterility, and may cause severe psychic trauma.

If after abortion tissue is known to be retained, it should be removed at once. If tissue is thought to be retained, the uterus should be explored at once. *No* harm will come from making certain of this important fact. In the management of incomplete abortion it is better to be sure than sorry. If bleeding is continuing, the indication for exploration of the uterus is very clear. Why wait for profuse hemorrhage? Oxytocics will rarely bring about complete evacuation of retained tissue.

* * * *

Case III. A twenty-eight year old woman disclaimed knowledge of a four-month pregnancy until two hours prior to admission to the hospital. She complained of severe abdominal cramps, vaginal bleeding and the partial extrusion of a fetus.

Examination showed a four-month fetus still in the vagina. The patient's blood pressure and pulse rate were within normal limits. The fetus was removed and ½ cc. of pitocin administered every half hour. Six hours later the patient began to bleed profusely. Intravenous glucose solution and 500 cc. of plasma were given. Blood transfusion was begun.

Twelve hours later the patient was still bleeding slightly but had responded to administration of 1,000 cc. of plasma and 1,000 cc. of blood. She was taken to the operating room where under cyclopropane anesthesia most of the placenta was removed manually, except for a small piece attached to the anterior surface of the uterus. This fragment was grasped with an ovum forceps, removed and the cavity of the uterus curetted sharply. Profuse vaginal bleeding and shock followed. The vagina and uterus were packed and glucose solution and more blood administered in both arms.

Two hours later the patient recovered from shock, but one hour after this severe pulmonary edema developed and she expired nineteen hours after admission. During the seven hours prior to death she had received 4,000 cc. of blood, 1,000 cc. of plasma and about 4,000 cc. of glucose solution. Autopsy showed marked pulmonary edema, bilateral hydrothorax, ascites and edema of all tissues.

Questions. (1) Should a sharp curet be employed for the removal of placental tissue after abortion at four months? What is the best technic for emptying the uterus in cases of incomplete abortion? (2) What was the cause of death? Was there a controllable factor?

Answers. A sharp curet should not be employed to empty a uterus of placental tissue in abortion at four months. The larger and softer the uterus, the blunter should be the instrument used and the greater the caution with which it is introduced and used. In early pregnancies, before the third menstrual period is missed, ordinary curettage may be employed. *Great care should be exercised in determining the position of the uterus by examination under anesthesia.* If the operator is unaware of flexion, perforation may easily result. A uterine sound should not be used to measure the depth of the uterus, but the largest curet the cervical os will admit.

In pregnancies as advanced as in this case the soft cervix will generally be found sufficiently dilated to admit a finger into the uterus for location and separation of placental tissue. General anesthesia and, if feasible, the introduction of the entire hand into the vagina will make this procedure easier. The anterior lip of the cervix may be grasped and steadied with a serrated sponge stick. A tenaculum may tear the soft friable cervix, or even without laceration may cause hemorrhage from small perforations. The other hand of the operator is used externally to locate the uterine fundus and steady it. After separation of placental tissue it may be grasped and removed with an ovum forceps or sponge stick. *If something is grasped which resists extraction, it is best to release it and explore the uterus again.* It may be myometrium or even intestine or omentum. Even an ovary has been removed in this fashion. Small fragments are of no importance. An oxytocic may be given at the end of the procedure.

In less advanced pregnancies than in this case it may not be possible to introduce the finger. The ovum forceps may be used provided the operator never forgets that, valuable though it is, the ovum forceps is a dangerous instrument. It is best not to attempt to tear tissue from the uterus forcibly or else, as noted heretofore, myometrium may be included or even perforation result. In such cases it may be necessary to loosen tissue with a dull curet. The largest dull curet that the cervix will admit should be used to stroke methodically yet quickly the entire uterus. A flexible stem curet can be bent to any desired curve and is particularly valuable in scraping the posterior surface of the uterus.

The cervix is usually open when abortion is incomplete. If it should be necessary to open the cervix, dilatation should be just sufficient to use the desired instrument. The soft cervix is easily lacerated if undue force is used.

The controllable factor in this case was delay in removal of retained tissue. Too vigorous use of the sharp curet for removal of a piece of tissue perhaps so small as to be innocuous caused more and unnecessary hemorrhage.

The immediate cause of death is found in the autopsy findings. The patient was given too much fluid and too quickly. We have, it is true, seen as much as 1,200 cc. of blood administered quickly without causing death, and as a

matter of fact much more than this has been given while blood is actually pouring out. There are factors other than the amount. Caution should be used. Even a sponge will reach a point where it will hold no more. The first thought in treatment of hemorrhage is not transfusion but to stop the bleeding. This lesson should not be hard to learn, yet it appears to be. There is no excuse for use of plasma except in great emergency and perhaps in isolated communities. Even in large cities there may be an isolated community or two.

* * * *

CASE IV. A young primigravida complained of abdominal pain and diarrhea. She stated that eleven days before admission to the hospital she fell and on the following day passed a small fetus and placenta. She had received no prenatal care and did not call a physician until two days after the abortion when she suffered abdominal pain and a fever of 103°F. The physician administered penicillin and again treated her in a similar fashion at home six days later. Hospitalization was not advised. Three days after his second visit the physician was again called because of severe abdominal pain. Citrate of magnesia had been taken by the patient.

On admission to the hospital eleven days after abortion the patient looked acutely ill and dehydrated. Her temperature was 103.2°F.; the abdomen was distended, with rigidity and tenderness over the lower half. Several vaginal examinations by members of the staff showed marked tenderness and induration in the vaginal fornices. The uterus could not be outlined. The leukocyte count was 27,000 with 90 per cent polymorphonuclears and the sedimentation rate 18 mm. in fifteen minutes. A blood culture was sterile.

A diagnosis of postabortal cellulitis and pelvic peritonitis was made and the patient was treated with gastric suction, intravenous fluids, blood transfusion, penicillin, streptomycin and sulfadiazine.

During her course in the hospital her temperature ranged from 101° to 104°F., the pulse rate from 90 to 130 and the respiratory rate from 24 to 38. Eight days after admission a suprapubic mass became easily palpable. The patient died on the following day. Autopsy showed retained infected placental tissue with septic endometritis and myometritis. The peritoneal cavity showed a large pelvic abscess and purulent peritonitis.

Questions. (1) The history indicated that abortion was due to a fall. Is this likely? (2) What is the role of infected retained placental tissue in causing mortality? What routine should be followed in the treatment of such cases? (3) Is repeated pelvic examination harmful? (4) What was the most likely pathogenic organism in this case? Which bacteria commonly cause septic abortion? Is blood culture sufficient? (5) Should abortal infection be treated at home?

Answers. The history of abortion following a fall at home can be disregarded. A generation ago lifting a wash boiler was the reason most often given. Since the laundry has been removed from the home, abortion is attributed to a fall. *We regard all severely infected cases as induced.*

Retention of placental tissue may be responsible for death. The uterus with necrotic infected tissue is fertile ground for bacterial growth and dissemination through lymphatics giving rise to fatal peritonitis as in this case, or to pelvic thrombophlebitis and generalized sepsis and embolization.

There is still a difference of opinion on the management of septic abortion when tissue is thought to be retained yet hemorrhage has not been sufficient to warrant its removal. It is true that too vigorous measures to remove infected tissue may break down defensive barriers and spread infection. Sulfonamides or antibiotics may be freely used as in this case; yet although these drugs are generally effective against dissemination of organisms from the placental site, they do not reach and so cannot act against bacteria in a necrotic thrombosed attached placental fragment.

We have settled this problem to our satisfaction. Our patients with septic incomplete abortion have their uteri *gently emptied* whether there is hemorrhage or not. Although chemotherapy and antibiotics have undoubtedly played their part in the reduction of abortion mortality, there are other factors.

Repeated pelvic examinations should be avoided in all cases of pelvic infection, and septic abortion is no exception to the rule.

Gentleness must be exercised in the actual emptying of the uterus. Inexperienced overenthusiastic operators may spread the infec-

tion. Dilatation of the cervix should be avoided if possible. The uterus should be sounded with the largest dull curet the cervix will admit. If one can introduce a finger into the uterus, fragments of tissue can be loosened and then removed with an ovum forceps or sponge stick. Intramuscular oxytocics may be indicated. *Blood transfusion is of great value,* for sepsis and anemia are frequently associated as the two enemies of recovery.

The organism which caused infection in this case was probably the anaerobic streptococcus. A common inhabitant of the vagina, it may become a deadly pathogen in the presence of necrotic tissue, blood and trauma. The colon bacillus and staphylococcus are also commonly found in septic abortion. Less common are Clostridium welchii, gonococci, pneumococci and hemolytic aerobic streptococci. Certain strains of Cl. welchii and the hemolytic aerobic streptococcus are the most virulent organisms. It is common for culture to reveal multiple organisms.

Blood culture alone is not sufficient. It is helpful to have uterine cultures taken, or at least a vaginal culture. Identification of bacteria will aid in the choice of antibiotics. If blood agar plates are streaked and broth culture inoculated with culture swabs, identification of the aerobic hemolytic streptococcus may be made within twenty-four hours. The plates will show the characteristic minute colonies surrounded by wide zones of hemolysis and the Lancefield microprecipitin method may be used to determine whether the organism is of Group A.

Abortal infection cannot be safely treated at home. In this case the physician who first treated the patient assumed the uterus to be empty when actually it was not. A history of completeness of an abortion is often unreliable; even examination of tissue passed may not definitely indicate whether the uterus is empty or not. The outcome in this case might have been different had early hospitalization occurred and retained tissue been promptly removed. Catharsis in the presence of peritonitis will help to spread the infection.

* * * *

CASE V. A twenty-four year old multipara aborted a six-week pregnancy at home, supposedly from a fall. She passed vaginal clots and suffered fever and chills for three days. On admission to the hospital the temperature was 102.2°F. and the pulse rate 140. The abdomen was distended and there was rebound pain. Vaginal examination showed a lacerated cervix and a tender fluctuant mass to the left of the uterus. The leukocyte count was 16,400 with 92 per cent polymorphonuclears. The erythrocyte count was 2,400,000 and the hemoglobin 6.5 gm. Vaginal culture reported anaerobic non-hemolytic streptococci, colon bacilli, and hemolytic and non-hemolytic staphylococci albus.

Treatment included large doses of penicillin. Four days after admission the mass increased considerably in size and was clearly fluctuant. The temperature spiked and eight days after admission the mass was so large that it filled the entire left lower quadrant of the abdomen up to the umbilicus.

The patient was taken to the operating room four days later and examined under anesthesia. No bulging into the vagina was noted and during the course of examination the mass disappeared. No operation was performed and the patient was returned to her bed. She died two days later. Autopsy showed a ruptured left tubo-ovarian abscess, generalized peritonitis and infected retained placental tissue.

Questions. (1) What is the pathogenesis of peritonitis, cellulitic abscess and tubo-ovarian abscess? (2) Did the pelvic examination rupture the abscess in this case? In general, what treatment is advised for abscess? (3) How serious is tubo-ovarian abscess? What is the treatment?

Answers. Peritonitis, the most common cause of death, may result from lymphatic spread from the decidua or more rapidly through the tubes. In perforation of the uterus it can occur with almost lightning speed. The characteristic spread of infection, however, is through the lymphatics to the cellular tissue of the pelvis. In induced abortion the cervix is the primary site. Cellulitis may cause the appearance of a hard exudate in the parametrium or elsewhere in the pelvis which may in time break down into an abscess. Tubo-ovarian abscess may occur, as in this case, by more direct involvement of the ovary through the tube. In any abscess formation risk of intraperitoneal rupture is present.

Pelvic examination under anesthesia, when

the patient's guard is down, is hazardous for it may rupture an abscess. Rupture occurred in this case and should have been promptly followed by operation.

The treatment of abscess depends upon its site and the tissue involved. For pelvic abscesses that point posteriorly, posterior colpotomy is obviously the best treatment. Parametrial abscesses are best incised and drained extraperitoneally just above and parallel to Poupart's ligament. *The tubo-ovarian abscess is formidable.* When laparotomy is necessary for threatened or actual intraperitoneal rupture, hysterectomy and bilateral salpingo-oophorectomy should be seriously considered. This may appear to be radical therapy, but experience has shown that the results justify this procedure. Antibiotics, blood and improved surgical technic now permit gross single contamination of the peritoneum and surgical field. Lesser measures such as simple incision and drainage often result in recurrent abscesses, chronic pelvic infection, invalidism and finally in some cases death.

* * * *

Case VI. A housewife twenty-eight years of age was admitted to the hospital for vaginal bleeding two months after her last period. Within an hour she had a chill followed by fever. Vaginal examination showed a sanguinopurulent discharge, a soft cervix which admitted the fingertip and a soft, tender uterus the size of a three-month pregnancy. The leukocyte count was 20,000 with 87 per cent polymorphonuclears; hemoglobin 80 per cent, erythrocyte count 4,100,100. A diagnosis of septic abortion was made.

Removal of probable retained tissue was not undertaken. Five days later, although the fever had abated somewhat, sulfanilamide therapy was instituted. During the next four days 320 gr. were given. Chemotherapy was discontinued when it was found that the hemoglobin had fallen to 45 per cent and the erythrocytes to 2,200,000. The temperature during the following week was septic in type, rising to 105.4°F. and falling to 99.6°F. intermittently. The patient was surprisingly free from subjective symptoms. Vaginal bleeding of moderate amount occurred almost daily. Transfusions of blood were given every second or third day. In spite of the large quantity of blood (4,275 cc.) which the patient received, the hemoglobin never rose above 58 per cent.

Four blood cultures taken during the three weeks after admission were positive for Streptococcus hemolyticus Group C. The source of the bacteremia was thought to be pelvic thrombophlebitis. After the report of the first positive blood culture sulfanilamide was again administered. Massive doses were now given and within ten days the patient received 890 gr. In spite of the intensive chemotherapy the patjent grew steadily worse.

On the twenty-first day after admission a rough systolic murmur was heard at the apex, and the spleen was found to be enlarged. Bacterial endocarditis was not suspected. The patient complained of sudden pain in the lower back and in both legs and expired shortly afterward. At autopsy the mitral valve was the seat of a large, friable vegetation. One of the leaflets had been destroyed by an ulcerative process; here the chordae tendineae were ruptured and detached. The greater part of the free border of the valve was involved in the necrotizing process. The remaining portion of the valve showed no evidence of old or chronic endocarditis, as it was thin and velamentous. On microscopic examination small abscesses were found throughout the myocardium. The spleen weighed 300 gm. and contained a large anemic infarct. A small infarct was present in one kidney. A large, white saddle embolus was lodged at the bifurcation of the aorta, completely occluding the lumen. The iliac arteries were collapsed and bloodless. The uterus was slightly enlarged; the fundus was globular and contained a large polyp-like mass of placental tissue covered with a yellowish necrotic exudate which extended into the myometrium. The remaining endometrium was dull, grey and covered with exudate. The aerobic hemolytic streptococcus recovered in the blood culture was identified serologically as Group C.

Questions. (1) What was the source for the invasion of the blood stream by the streptococcus? (2) What is the virulence of the various strains of the aerobic hemolytic streptococcus in abortal infections? (3) What is the pathogenesis of septic pelvic thrombophlebitis? Of bacterial endocarditis? Can these complications be determined clinically? (4) How can one explain the persistent anemia

in this case despite the large quantity of blood given by transfusion?

Answers. Although evidence of pelvic thrombophlebitis was not found at autopsy, it is probable that the retained infected placental tissue was the source for the invasion of the blood stream by the streptococcus, with subsequent development of endocarditis and persistent bacteremia.

The majority of human streptococcic infections are thought to be due to members of Group A. Streptococci of Group C have been regarded as generally pathogenic for animals rather than man, and so this patient must be regarded as unusual. Fatalities due to Group B infections have been reported, including cases of vegetative endocarditis, similar to that described in this patient.

Septic pelvic thrombophlebitis may result from the spread of infection along veins from infected thrombi at the placental site. This is one of the most serious complications in abortal infections but fortunately occurs in only a small number of cases. Showers of bacteria may enter the blood stream from time to time. The ovarian, uterine or iliac veins may be involved and serve as foci for dissemination of septic emboli to the lungs causing septic infarcts, lung abscess and empyema. Cellulitis often accompanies involvement of pelvic veins. Abscess formation may occur anywhere along the course of an infected vessel. When thrombosis extends to the femoral vessels, the typical picture of phlegmasia alba dolens results. The veins or lymphatics may transport bacteria to the cardiac valves even without primary thrombophlebitis.

The clinical picture of pelvic thrombophlebitis is one of spiking high temperatures and chills as a result of showers of bacteria into the blood stream. Pelvic findings are meager and the patient usually looks surprisingly well between her febrile episodes. If the infection persists, sooner or later she will show clinical signs of septic infarction of the lungs. Repeated blood cultures may disclose the organism. Clinical recognition of bacterial endocarditis may be difficult. Evidence of septic pelvic thrombophlebitis accompanied by a new cardiac murmur, splenomegaly, positive blood cultures, petechiae and embolization makes this diagnosis likely.

The persistent anemia in this patient, despite the large quantity of blood given by transfusion, was due to sulfanilamide and hemolysis by the streptococcus.

* * * *

Case VII. A twenty-five year old multipara noted some slight vaginal bleeding when about four months pregnant. During the next two months the uterus failed to increase in size and she was taken to the operating room because of recurrent vaginal bleeding. The cervix was dilated and the membranes were ruptured. This was followed by the escape of cloudy fluid and increased bleeding. The vagina and uterus were than packed but bleeding continued.

Vaginal hysterotomy was performed and the uterus emptied. Following the operation the patient became cyanotic, her temperature rose to 106°F., pulse to 130, respirations to 45, and she died within a few hours. There was no autopsy.

Case VIII. The patient was a thirty-nine year old multipara with a missed abortion. The uterus was the size of a three-month pregnancy despite five months of gestation. A catheter was inserted into the uterus and the vagina packed. This procedure was followed by peritonitis and death a week later. Treatment had included large doses of antibiotics.

Questions. (1) How should missed abortion be managed? Are attempts at surgical induction of labor hazardous?

Answers. Intrauterine death is usually followed by uterine contractions sooner or later, and expectant treatment is all that is necessary. *Rupture of membranes and cervical manipulation are particularly dangerous because of the ease with which the dead uterine contents may be infected and the severity of the infection.* With a uterus three months in size or larger, expectant treatment may include priming the uterus with repeated large doses of estrogens followed by the administration of pituitrin. Results are variable and cannot be depended upon. Surgical procedures are rarely indicated in the treatment of missed abortion. If the pregnancy has not progressed beyond the tenth week, curettage is indicated but only after a period of waiting of four or more months. Abdominal hysterotomy will be indicated for later missed abortion but only after a period of six or more months. The

psyche of the patient is important. In stable individuals one may wait even longer.

* * * *

CASE IX. A twenty-eight year old primigravida was admitted to the hospital because of abdominal pain and vaginal bleeding following two months of amenorrhea. Vaginal examination showed a patulous cervix and tissue in the vagina.

Under sodium pentothal anesthesia a uterine sound was introduced to a depth of 3 inches and a sponge stick used to remove tissue from the uterus. The tissue was then seen to be intestine. Laparotomy disclosed a rent in the anterior lower uterine wall and a portion of small intestine without its mesentery. The rent in the uterus was sutured and an intestinal anastomosis performed.

The patient's postoperative course seemed satisfactory for the first three days. Following an enema on the fourth day she went into shock, became distended and toxic and died two days later.

CASE X. An unmarried girl attempted abortion with a knitting needle after two months of amenorrhea. She was admitted to the hospital three weeks later because of continued vaginal bleeding. Her temperature was 102°F. and she appeared to be anemic. Vaginal examination showed profuse purulent bloody vaginal discharge and a mass to the left of the uterus.

Her temperature fluctuated from 98.6° to 106.6°F. and she had chills, tachycardia and persistent vomiting. Repeated blood cultures were negative but cervical cultures showed colon bacilli and non-hemolytic streptococci.

Death occurred four weeks after admission. Autopsy revealed suppurative peritonitis due to perforation of the uterus and sigmoid.

CASE XI. A thirty-one year old primigravida was admitted to the hospital with a ten-week incomplete abortion. The uterus was emptied with an ovum forceps and then lightly curetted with a dull curet. This procedure was immediately followed by abdominal pain, rigidity, vomiting and distention. The acute phase of this illness subsided within a few days but left lower abdominal pain persisted and the patient ran a febrile course with temperature rises to 102.4°F. Her temperature became normal after three weeks in the hospital, symptoms disappeared and after being ambulatory for one week more she was discharged from the hospital.

Because of recurrence of lower abdominal pain and the appearance of gastrointestinal symptoms, x-ray examination was performed and showed "some disturbance in the small intestine." The patient was admitted to another hospital three weeks after her discharge from the first and became rapidly worse, developing signs of peritonitis with a fluctuant mass filling the pelvis. On the day of her death, the third day of this admission, posterior colpotomy yielded a considerable amount of foul-smelling pus. Autopsy showed an old perforation of the ileum with generalized peritonitis.

Questions. (1) How frequent is perforation of the uterus? How serious is this accident? (2) How may perforation of the uterus be prevented? How can it be recognized when it occurs? (3) What is the management of perforation of the uterus? Is there a place for expectant treatment? Should hysterectomy be performed?

Answers. The incidence of perforation of the uterus is unknown. The more inexperienced the operator, the more likely it will occur. The gravity of this complication depends on the type of case, how the accident occurred, involvement of tissues and organs outside the uterus, prompt recognition and adequate treatment. It may be a serious complication and carries a high mortality.

For prevention, the following recommendations are made:

1. The bladder should be emptied by a catheter. A distended bladder will cause displacement of the uterus and make it difficult to outline.

2. Knowledge of the size, consistency and position of the uterus is essential. Curettage in the dark is dangerous.

3. The depth of the uterus must be known. Its determination is an important and perhaps a dangerous procedure. The uterine sound should not be used; it may easily go through the softened myometrium. A large dull curet is a reasonably safe instrument, the curve of the instrument corresponding to that of the cervix and body of the uterus. In the great majority of cases the depth of the uterine cavity can be estimated by bimanual examination.

4. The cervix should be sufficiently dilated to permit adequate evacuation of tissue. The graduated dilators are preferred to the Goodell dilator which is more likely to lacerate the cervix. Care must be taken not to permit a small dilator to slip suddenly past the internal os, else it may go on to perforate the uterus. Here again the curve of the dilator must correspond to that of the uterus.

5. *The safest instrument is the gloved finger,* but it may not be easy to introduce the finger into the cavity of the uterus. This procedure will be facilitated if the whole hand may be introduced into the vagina. Counter-pressure on the fundus of the uterus with the other hand will aid. With the finger introduced into the uterus, tissue can be loosened and easily removed with sponge stick or ovum forceps.

A diagnosis of perforation can be made when an instrument has passed beyond the depth of the uterine cavity. In a clean case expectant treatment is advised. Any evidence of internal hemorrhage or the development of pelvic peritonitis will necessitate laparotomy. Without history diagnosis of perforation of the uterus is difficult, for infection spreading beyond the uterus may produce a similar syndrome. A history of shock or the development of signs of severe infection soon after manipulation is important. Lacerations or puncture wounds of the vagina or cervix should be given due weight. If the uterus is known to be empty, if peritonitis is spreading in spite of adequate antibiotic therapy, the patient's abdomen should be opened. Only occasionally will the diagnosis of perforation fail of confirmation.

Perforation of an infected uterus usually means hysterectomy, for the danger of fatal peritonitis is great.

* * * *

CASE XII. A markedly obese primigravida three months pregnant was admitted to the hospital because of acute abdominal pain, nausea and vomiting for two days. The pain was at first generalized and later localized to the right lower quadrant of the abdomen with maximum tenderness over McBurney's point. There was marked peritoneal rebound pain. The leukocyte count was 12,500 with 86 per cent neutrophils. A diagnosis of acute appendicitis was made.

At operation the uterus was soft, the size of a three-month gestation. A fibromyoma arose from the posterior surface of the uterus and both the uterus and the tumor were found deep in the pelvis and were delivered with difficulty. The fibromyoma was then seen to be softened, have a broad base and to penetrate deeply into the musculature of the uterus.

The appendix was found retrocecally and was about 6 cm. long. Although it showed no evidence of gross infection, it was removed. Microscopic examination showed a normal appendix.

Six days after operation the patient aborted. Her temperature then rose to 102.2°F. and the abdomen became distended. For the next five days her temperatures ranged from 102° to 104°F., the pulse from 120 to 140 and the abdominal distention became marked. Evisceration with purulent discharge from the wound occurred on the seventh day. Culture of the pus showed a hemolytic staphylococcus aureus. The bowel was reposited and the wound strapped with adhesive tape. The patient died of peritonitis on the twelfth day.

Questions. (1) What was the true diagnosis in this case? (2) Was appendectomy indicated? (3) What should have been the treatment? Should myomectomy have been performed?

Answers. The diagnosis was red degeneration of a fibromyoma. It occurs more frequently in a pregnant uterus and can be responsible for acute symptoms which may cause concern. Diagnosis depends upon finding a fibromyoma which is the site of pain and tenderness.

Appendectomy was unnecessary and hazardous. The patient should not have been operated upon at all. Errors in diagnosis, however, do occur and in this case perhaps were excusable; but after the abdomen had been opened, prophylactic appendectomy should not have been performed.

The treatment of red degeneration of a fibromyoma, particularly during pregnancy, is conservative. Myomectomy is never indicated. Bed rest and sedation should be sufficient.

* * * *

CASE XIII. An eighteen year old unmarried primigravida was admitted to a hospital with the history of vaginal bleeding twelve hours after falling down stairs. She had missed four menstrual periods. Instrumentation was denied.

The patient's temperature was 100°F., pulse 130 and blood pressure 96/70. The hemoglobin was 6.5 gm. The fundus of the uterus, felt 2 fingerbreadths beneath the umbilicus, was very tender. Protruding from the cervix were shreds of foul-smelling tissue and fetal parts.

Under intravenous sodium pentothal anesthesia the uterus was emptied of large amounts of placental tissue by using a finger and sponge stick, followed by dull and sharp curettage. Catheterization yielded several hundred cubic centimeters of brownish black urine giving a positive benzidine reaction. The urine showed 4 plus albumin and was loaded with red blood cells.

Seven hours after admission the general condition of the patient became critical. The abdomen showed rigidity and tenderness and the patient was jaundiced. Treatment on admission included streptomycin, penicillin and 500 cc. of blood by transfusion. For the ensuing three days the patient was almost completely anuric and in shock. The temperature never rose higher than 102°F. Fluids were limited to 1,800 cc. per day, including 500 to 1,000 cc. of blood. The urinary output was never more than 25 to 30 cc. of bloody urine during each of the twenty-four-hour periods up to her death on the sixth day. On the day prior to death, examination of her blood showed the urea to be 125 mg. per cent, creatinine 8.5 mg. per cent, uric acid 11.7 mg. per cent, CO_2 combining power 33.4 mg. per cent and sugar 128 mg. per cent. Autopsy showed marked distention of the intestines, marked pulmonary edema, many petechial hemorrhages and lower nephron nephrosis.

CASE XIV. A primipara was admitted to the medical ward of a hospital because of general weakness, diarrhea and fever of a few days' duration. She gave no history of amenorrhea, stating that what she interpreted as her current menstrual period had begun two days previously and that she had never been pregnant. She was acutely ill and jaundiced. The temperature was 101°F., pulse 100 and respirations 24. Pelvic examination revealed a patulous cervix with moderate bloody discharge. The uterus was reported to be of normal size and no pelvic masses were palpable. Because of the misleading history a diagnosis of infectious hepatitis was made.

During the six days prior to the patient's death, laboratory examination showed the blood urea to be 384 mg., creatinine 10 mg. and the icterus index 60 units. The specific gravity of all urine specimens was under 1,012 and the albumin 4 plus. The erythrocyte count was 2,800,000 and the leukocyte count 48,000. Oliguria was marked. On the patient's fourth hospital day her urinary output was 110 cc. despite a fluid intake of over 2,000 cc. Drowsiness and stupor appeared and increased steadily until her death. Autopsy showed decidual endometritis and lower nephron nephrosis.

Questions. (1) What is the clinical picture of lower nephron nephrosis as seen in septic abortion? What is the pathology? (2) What is the treatment?

Answers. The lower nephron syndrome, which occurs in a wide variety of conditions such as the "crush syndrome," burns, poisoning and shock, can occur in septic abortion. The essential clinical features are progressive oliguria and retention of non-protein nitrogenous products. Jaundice may be seen. The usual pathology is commonly said to include necrosis of the distal convoluted tubules and the deposition of heme casts. More recent evidence indicates that necrosis is not necessarily limited to the lower nephron but is more widespread. Actually the entire nephron is involved, not the lower nephron alone.

Treatment should include the prevention of shock, a potent factor in itself for the production of this syndrome, and early removal of retained tissue. Some investigators have incriminated a nephrotoxic substance derived from dead or dying placental tissue. *Limitation of fluids until regeneration of tubular epithelium occurs is the essential part of the treatment.*

CONCLUSIONS

There are at least four measures which can be taken to reduce further the number of deaths from abortion:

First is the adequate treatment of the nonseptic abortion accompanied by profuse hemorrhage. Although it has been said that rarely does a patient who has had an abortion die of hemorrhage, this is sheer nonsense. In many cases deaths occur sufficiently long after hospital admission to indicate that proper and timely treatment of blood loss would have prevented death.

Second is the recognition of the necessity

for the surgical treatment of certain post-abortal intra-abdominal abscesses. Spontaneous rupture of such abscesses into the peritoneal cavity almost always causes death.

Third in the removal of retained tissue. The role of this tissue in initiating and continuing severe general infection which may ultimately result in death has been adequately shown.

Fourth is education of the public. Every doctor has a definite obligation to the patient who indicates a desire or determination to be aborted illegally. He should attempt to dissuade her by informing her not only of the danger of death but also of the risk of subsequent sterility with its possible psychic trauma, chronic pelvic infection and disability.

COINCIDENT disease of the coronary arteries and of the gallbladder are common since both occur in the same age group and often because of the same causes. Of course, only one disease may be present and it may become a tragedy if a patient with a severe coronary condition is subjected to cholecystectomy. However, patients with coronary sclerosis and positive electrocardiogram tracings, if they have a badly diseased gallbladder, are often greatly improved after surgery and the abnormal electrocardiogram tracing may even return to normal after a successful operation. The moral, of course, is not to operate on a primarily cardiac case. (*Richard A. Leonardo, M.D.*)

Practical Surgical Suggestions

INTRA-ABDOMINAL CHOLEDOCHOGRAPHY*

PRELIMINARY REPORT OF A METHOD OF DETECTING STONES IN THE COMMON BILE DUCT

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DESPITE numerous advances in surgery of the biliary tract the common duct stone missed at operation remains a serious problem. As late as 1947 Pribram[6] estimated that 16 to 25 per cent of patients operated upon for choledocholithiasis were found later to have retained common duct stones. This unfortunate situation is caused by descent of intrahepatic stones into the common duct postoperatively or the failure of the surgeon to detect an imbedded stone in the lower portion of the duct during his probing of the duct. Cole,[2] Strickler[8] and Hagan[3] have emphasized the frequency with which stones in the common bile duct are overlooked during probing. Partington,[5] Sterling,[7] Cole[2] and Bonn[1] have pointed out that the majority of overlooked stones are in the common bile duct rather than the common hepatic or hepatic ducts. In a review of seventeen postoperative cholangiograms visualizing retained stones we found fourteen or 82 per cent to be imbedded in the lower portion of the common duct. This is a higher figure than the usually reported 60 per cent occurrence in this area. The remaining three films indicated descent of multiple stones from the intrahepatic ducts.

Operative cholangiography would seem the answer to this problem. However, the difficulties of controlling respiratory motion during exposure of the film have caused most surgeons to discard it and accept the hazards of overlooked stones. Strickler et al.[8] mention the unsatisfactory cholangiogram as a cause of overlooked stone.

The preponderance of overlooked stones in the lower part of the common duct and the present difficulties with operative cholangiography have led us to seek a simpler, more easily applied method of visualizing this area roentgenologically. Although we realize the shortcomings of such a method because of failure to visualize the common hepatic and intrahepatic ducts, we believe that if satisfactory it might eliminate more than 50 per cent of stones overlooked at operation. This differs from other cholangiographic methods in that the x-ray film is placed behind the mobilized bile duct inside the abdominal cavity. Here the film and bile duct move as a unit with respiration so that

FIG. 1. Plastic-enclosed cardboard film holder.

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respiratory motion does not interfere with exposure of the film.

METHOD

A 3 by 4 inch x-ray film in a plastic-enclosed cardboard film holder (Fig. 1) is sterilized in 1:1000 zephiran solution for thirty minutes. Cholecystectomy and exploration of the bile ducts should include mobilization of the duodenum and head of the pancreas after the method of Kocher. (Fig. 2A and 2B.) After the T-tube has been inserted and the common bile duct sutured, the sterile film holder is slipped into the space beneath the common bile duct and mobilized duodenum. (Fig. 2B.) The water-tightness of the sutured common duct is checked by saline injection through the T-tube.

A self-retaining retractor is inserted (Fig. 2B) to hold the margins of the incision (rectus splitting, transverse or paracostal) apart and the tube of a portable x-ray unit is centered over the curve of the duodenum at a distance of 30 inches from the surface of the operating table. After 15 to 20 cc. of 35 per cent diodrast have been injected through the T-tube, a one and a half second exposure is made using 60

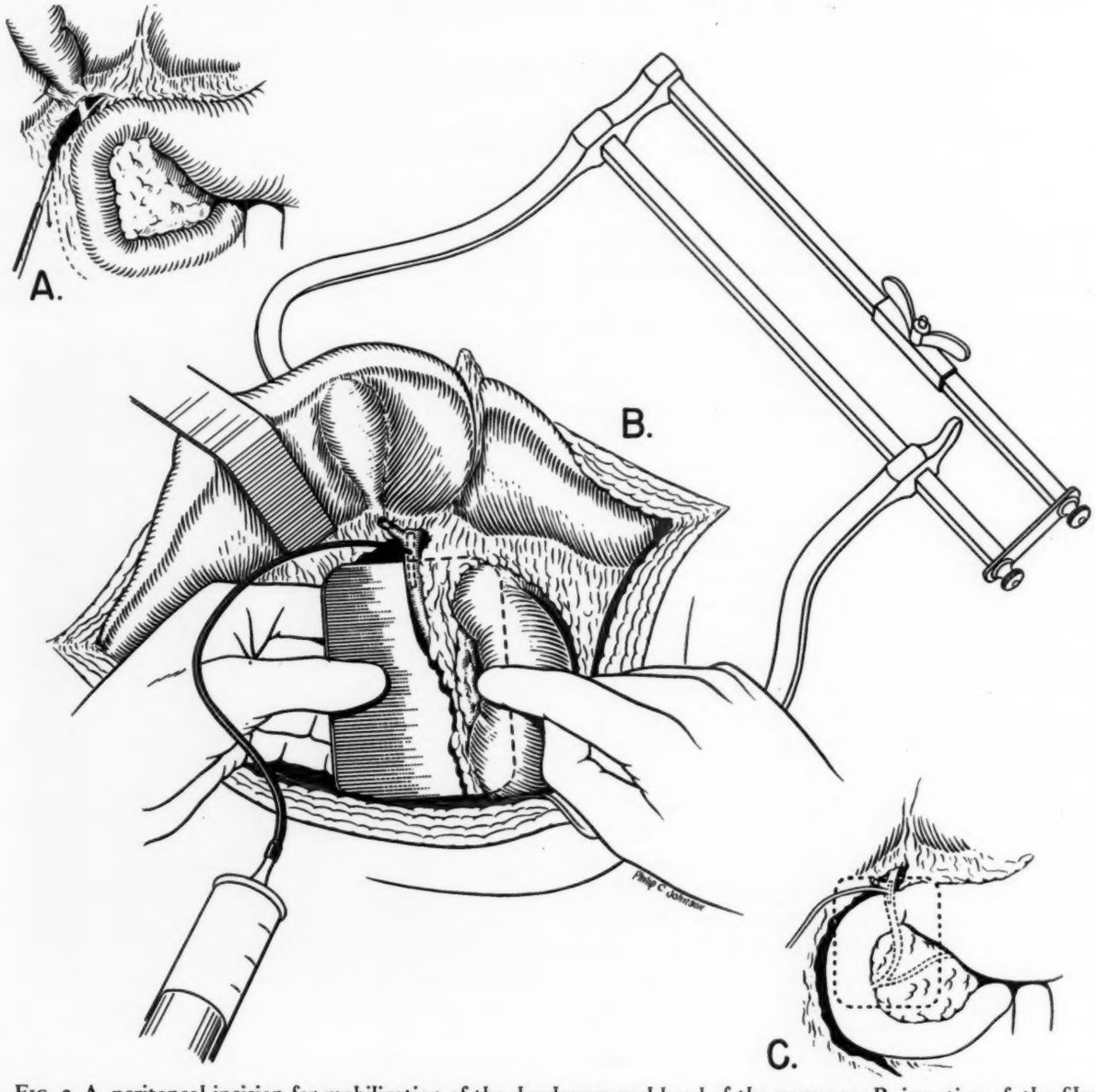

FIG. 2. A, peritoneal incision for mobilization of the duodenum and head of the pancreas; B, insertion of the film holder behind duodenum and head of the pancreas; C, film holder in place.

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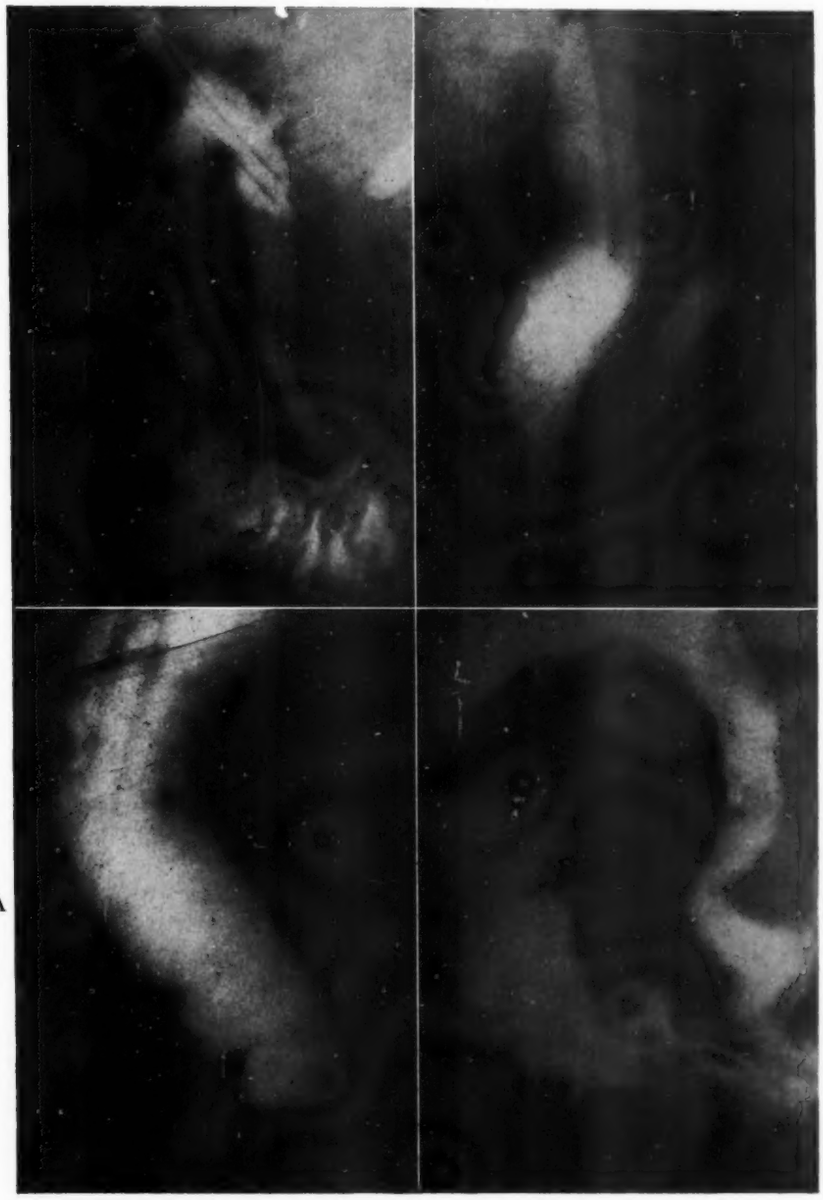

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5A

5B

FIG. 3. Intra-abdominal choledochogram showing normal common bile duct and terminal portion of pancreatic duct.

FIG. 4. Intra-abdominal choledochogram showing common bile duct and large portion of the pancreatic duct.

FIG. 5. A, intra-abdominal choledochogram showing stone impacted in lower end of common bile duct; no dye has entered the duodenum; B, after removal of stone seen in Figure 5A by morcellation; there is normal emptying of the common bile duct and the pancreatic duct is visualized. Small fragments of stone remaining in mid-portion of common bile duct were removed before closure of the abdomen.

kilovolts and 50 milliamperes. No effort is made by the anesthetist to produce temporary apnea. The holder is removed and the film developed immediately so that the status of the common bile duct may be known before the abdomen is closed.

COMMENTS

This method is applicable whenever operative cholangiography is unsatisfactory or cannot be performed. Consistently good operative cholangiography depends upon synchronizing the injection of contrast media and exposure of the x-ray film with arrest of respiratory motion by the anesthetist. This requires that the same group work together as a team constantly. Partington and Sachs[4] have emphasized that their failures were associated with the advent of new resident personnel who were not thoroughly familiar with the procedure. Obviously very few surgeons can have the same personnel available for each operation upon the biliary tract. The method presented eliminates the need for arrest of respiratory motion and is largely a one-man performance by the surgeon, who is dependent upon the x-ray technician only for the actual exposure of the film. Exposure through the open wound allows use of a constant set of roentgen ray factors for a given unit, obviates soft part interference in obese patients and permits the usual manner of securing drapes about the operative incision with towel clips.

The mobilization of the duodenum and head of the pancreas facilitates exploration of the common duct. Bonn[1] has advised this maneuver in all common duct explorations. Small stones can be palpated after failure to detect them by the usual method of palpation. The removal of imbedded stones is also easier after mobilization of the duodenum as the operator's left hand can steady the duct firmly while the right uses a scoop or stone forceps within the duct.

This method has been used on twenty-four patients with two failures. No complications occurred attributable to its use. Illustrative choledochograms are shown. (Figs. 3, 4, 5A and 5B.)

SUMMARY

A method of intra-abdominal choledochography has been presented which obviates the principal difficulties of operative cholangiography. This is done by placing the x-ray film behind the common bile duct within the abdomen thereby eliminating the necessity for apnea during the exposure of the film. This visualizes the common bile duct where the majority of stones are overlooked.

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ABDOMINAL DRAINAGE IN CIRRHOSIS BY USE OF GLASS BUTTON

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THOMAS Tannahill[1] in 1930 reported the use of a glass button in the treatment of ascites in cirrhosis of the liver. He stated its use lay in the fact that it prevented repeated paracentesis. Credit was given to Professor Peter Paterson of Glasgow University for the design has been used. A typical case history follows:

A. B., a thirty-nine year old Italian male laborer, was first seen in May, 1934. He was a heavy drinker of wine, consuming 1 to 2 gallons daily. His complaint was progressive increase in the size of his abdomen, loss of appetite and general weakness. Previous medical treatment had not benefited the patient. He was 6 feet 3 inches tall with a dissipated expression, dry tongue and moist skin but no jaundice. The heart was small for so large a person (weight 218 pounds); there were no murmurs and the lungs were clear. The abdomen was large and distended; marked dilated veins and "spiders" were present as well as fluid. The liver was palpable three fingerbreadths below the costal cartilage; spleen and kidneys were not palpable. Red blood count was 4,215,000, hemoglobin 11.5, white blood count 11,500, neutrophils 80 per cent, non-protein nitrogen 31 mg. and total protein 5.9 gm. Wassermann test was negative. Liver function tests were not done. Blood pressure on numerous occasions was low, averaging 110/70.

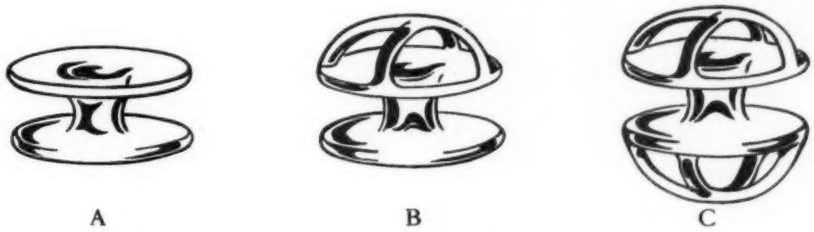

FIG. 1. Original button of Tannahill with subsequent modification.

type of button. One case was reported by Tannahill of alcoholic cirrhosis.

It was in 1934 that this method was demonstrated to the author at the General Hospital in Montreal. It was successful in preventing repeated tapping of the abdomen.

In 1896 Drummond and Morrison[2] reported the first surgical treatment of ascites. For years the Talina-Morrison[3] procedure was the only surgical procedure for the relief of ascites. Mayo[4] and others reported poor results and such a high mortality rate with this procedure that it was dropped by most surgeons. In 1946 Crosby and Cooney[5] reported five cases of cirrhosis treated by a button of their design with satisfactory improvement.

Certain diseases of the human as well as the animal body are prone to produce ascites. The most common diseases encountered are cirrhosis of the liver, cancer, tuberculosis, heart disease and kala-azar. The actual mechanism of the production of ascites still eludes us. There are various factors known but many of the popular concepts as to its cause have been eliminated by experimental work done at Mayo Clinic.[6]

This report will deal with thirty-six cases of ascites in which the original button of Paterson with modification of the position as well as the

Under local anesthesia two buttons of the original type were inserted after the removal of 20 L. of straw-colored fluid. The patient has not been tapped since. He no longer drinks wine and in May, 1948, total protein was 7.3. The buttons have not been removed.

All the cases reported in this series whose results have been classified as excellent have had equally as good results.

The original button as shown by Tannahill

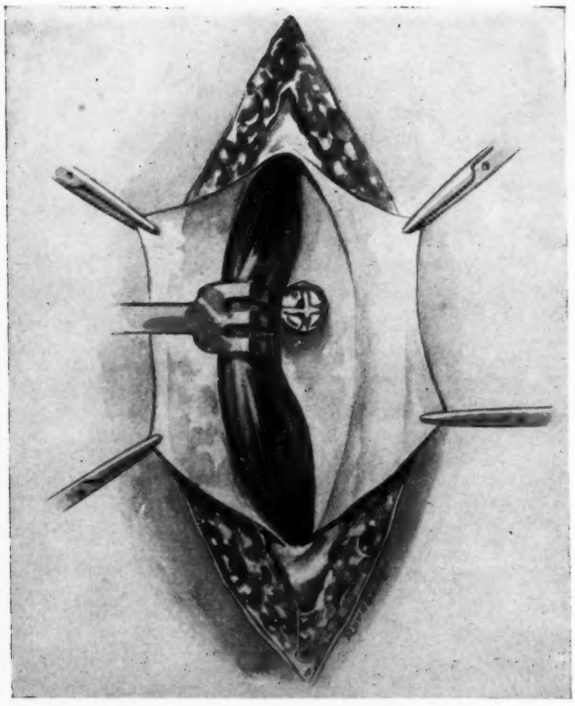

FIG. 2. Insertion of button through rectus sheath.

was a bobbin type made of glass, approximately 1.5 cm. in diameter and 1 cm. or more if desired in length. (Fig. 1A.) This type of button was used in thirteen cases: two cases of abdominal tuberculosis, two of malignancy with ascites, one of cardiac ascites and eight of cirrhosis of the liver. One case of cirrhosis was very far advanced with marked liver damage.

In one of the patients with cirrhosis whose result had been satisfactory for two years the ascites returned. He was reoperated upon and it was found that the abdominal opening in both buttons was plugged with omentum. This necessitated modification of the button. (Fig. 1B.) The original button was then modified to have a basket over the abdominal opening to prevent if possible a recurrence of obstruction. Two of the modified original buttons were inserted at that time, in different locations. The patient did well for six months when the ascites recurred. In the meantime, further modification (Fig. 1C) had been added. Again the patient was given the benefit of the latest modification which had a basket over each opening and he has not been tapped for four years.

TECHNIC

Two buttons are inserted about 1 inch below the umbilicus, beneath the rectus muscle on each side. (Fig. 2.) Under procain, (2 per cent) local anesthesia a 2 inch incision is made through the skin and subcutaneous tissue. A similar incision is made into the anterior rectus sheath, the rectus muscle is retracted laterally, a stab incision 1 cm. long is made between two hemostats and the abdomen is opened. All fluid is evacuated from the abdominal cavity by suction. The button is then threaded on black silk of sufficient length and a hemostat placed on the end. This is done to prevent loss of the button within the abdomen. The button is then thrust into the opening. (Fig. 2.) The silk is removed and the rectus muscle allowed to assume its normal position. The rectus sheath and skin are closed with fine interrupted black silk. This procedure is then repeated on the opposite side with a complete new operating set. Figure 3 shows the buttons in place in cross section.

TABLE 1
RESULTS

Type of Cases	No. of Cases	Result
Tuberculosis	2	Failure
Malignancy	2	Failure
Cardiac	1	Failure
Cirrhosis	26	Excellent
	1	Fair
	4	Failure

To date no deaths have been attributed to this procedure. There has been one infection around one of the buttons. This occurred two months after the patient had had a bowel resection for a large strangulated hernia, and necessitated incision and drainage but not removal of the button.

The results of this series of thirty-six cases may be found in Table 1.

COMMENTS

It has been estimated that 1 L. of ascitic fluid may contain as much as 100 gm. of protein. It seems rational to the writer that by keeping the protein waste at a minimum the general condition of the patient would improve and add greatly to the general treatment. It is known today that the liver will accept damage to a greater degree than formerly thought. This was brought out by McIndoe[7] and others. The two failures in abdominal tuberculosis, the

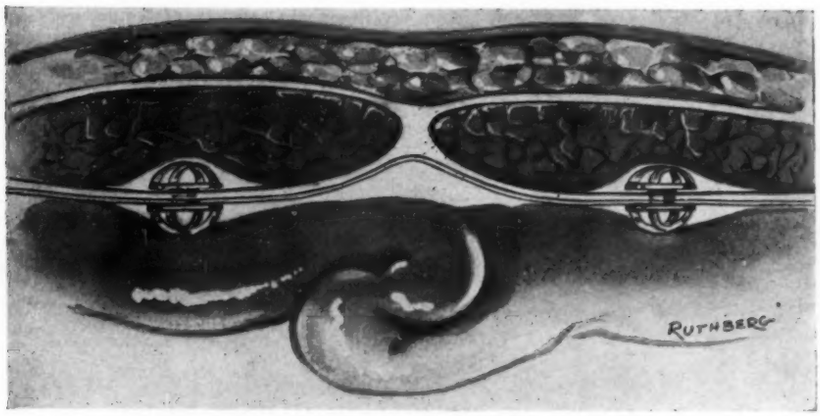

FIG. 3. Cross section showing position of buttons.

two failures in malignancy and the one in cardiac disease were sufficient to warrant us not to use this procedure in any further cases of these types. The four failures were in far advanced cases of cirrhosis in which reversal was not possible. It would seem that the indications are early cases of ascites due to cirrhosis. The procedure is not intended in any way to supercede the modern medical management but is offered as an adjunct in the treatment.

SUMMARY

1. A modification of the method reported by Tannahill is presented. The button has been modified and the position of the button has been changed.

2. The results of thirty-six cases in which patients were treated by use of buttons are presented.

3. A new technic of insertion is presented.

4. The procedure is advocated to prevent loss of protein in early cirrhosis of the liver with ascites.

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CECOSTOMY*

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WHENEVER cancer of the colon is under discussion, the relative merits of cecostomy and transverse colostomy for preparation of the obstructed bowel are invariably compared. The advantages and disadvantages of each method are well known.

Transverse colostomy has the advantage that preparation of the colon can be readily accomplished in all cases. Its disadvantage lies in the fact that the location is less desirable, especially for lesions in the neighborhood of the splenic flexure. Closure is also more difficult since it is usually impossible to fashion a spur, so that not infrequently to avoid narrowing it is more feasible to resect the colostomy and perform an end-to-end anastomosis.

Although cecostomy has the advantage of satisfactory location and ease of closure, adequate cleansing is often difficult or impossible unless the bowel is exteriorized. The only advantage of the intraperitoneal cecostomy is that the wound heals spontaneously when the tube is removed and an additional operation is avoided.

In order to obviate the objections to the two procedures it has been our policy to use an exteriorized cecostomy. The large dilated cecum after decompression is readily brought to the surface and sutured to the skin. When this is done, preparation can be carried out without difficulty; and the closure of the cecostomy is a minimal and easily accomplished operation compared to the closure of a transverse colostomy.

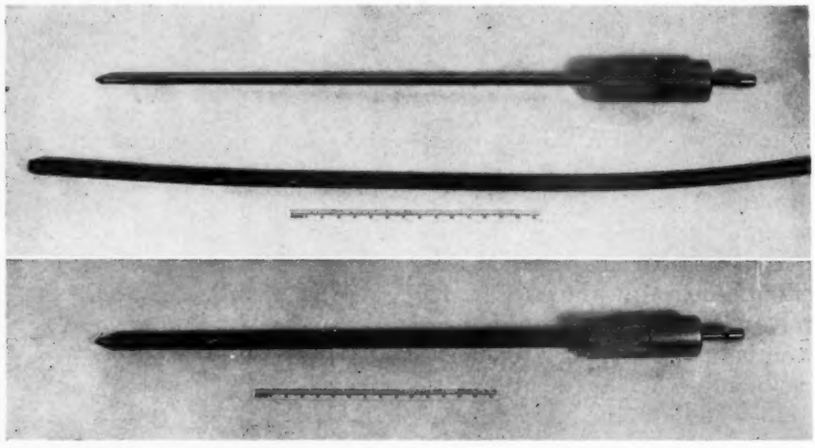

FIG. 1. Suction trocar which corresponds in size to the lumen of a No. 30 rectal tube.

FIG. 2. The trocar and tube after being attached to suction are ready for use. Note trocar tip with suction openings extending beyond the end of the tube.

It is frequently difficult to insert a large tube into a cecum which is greatly distended with air and fecal contents without having gross contamination of the wound or possibly the peritoneal cavity. The usual methods that have been applied are aspiration of the cecum with a large bore needle attached to suction, and the use of a trocar, also attached to suction, through which a catheter can be introduced. However, when the trocar is withdrawn, the external surface of the catheter is grossly contaminated with fecal material. Spillage may occur if an attempt is made to thrust a catheter into the lumen of the bowel through a stab wound even though reasonable decompression has been accomplished.

For the aforementioned reasons, a special instrument has been devised which has over-

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come these difficulties and allows the cecostomy to be performed as an aseptic procedure. This instrument, which provides suction and decompression, carries the catheter on its outside surface so that when the trocar is withdrawn the outside of the catheter is not contaminated. (Figs. 1 and 2.)

The trocar and the inside surface of the rectal tube are well lubricated with oil after which the trocar is thrust through the lumen. The tube is cut to allow the piercing end of the trocar with its suction openings to extend just beyond its tip. A size 30 rectal tube is employed. The suction trocar and tube are then thrust into the cecum which is rapidly decompressed allowing for the easy placement of two purse-string sutures. The trocar is partially withdrawn and the sutures are tied about the rectal tube, after which the trocar is removed and the catheter clamped off. The collapsed cecum is then drawn out to or above the skin surface and sutured to it with interrupted atraumatic chromic catgut. The wound is then closed.

Lavage of the colon is begun immediately through the rectal tube, which may be removed on the fourth day, and the cecal stoma enlarged if there has been difficulty in eliminating fecal material.

SUMMARY

1. An instrument is described which makes it possible to carry out an aseptic cecostomy in the presence of an obstructed and dilated colon.

2. It is suggested that the exteriorized cecum should have wider usage as a method for preparing the large bowel for definitive surgery.

THE TUBE BUNDLE SURGICAL DRAIN

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EVEN in these days of antibiotics and improved surgical technic there are some surgical cases which require drainage.

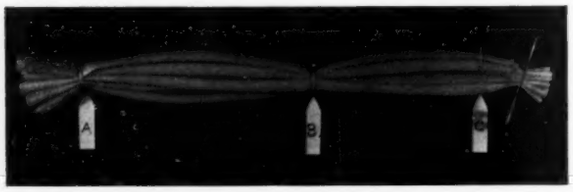

FIG. 1. Photograph of tube bundle drain.

We agree with most surgeons that all cholecystectomies should be drained in order to prevent the danger of bile peritonitis in case there is a leak at the ligated cystic duct, in case accessory cystic ducts have been opened in separating the gallbladder from the liver bed or if there is bile drainage from the liver bed itself. We believe it is also a good plan to use drainage in some cases of gastric resection in which there may be some doubt as to the integrity of the closed duodenal stump. It is in these types of cases as well as in those in which frank pus is encountered in the peritoneal cavity that we believe this tube bundle drain is highly satisfactory.

A picture of the drain is shown in Figure 1. It is made up of six lengths, usually about 12 inches long, of ¼ inch diameter latex Penrose drainage tubing. These lengths of tubing are loosely bound together at points A and B by plain zero catgut. After tying, the ends of the catgut are cut short in order that the knot will untie a few hours after the drains are inserted, which facilitates removing one or more tubes at a time as desired. A safety pin is used to fasten the ends of all tubes together in order to prevent the retraction of any of them into the wound. When drainage is desired, the drain is placed as in the usual manner with the ends joined by the safety pin protruding from the wound. In case the drain is too long, of course it can be shortened and the safety pin again inserted through all lengths of the tubing. By cutting the tubes at point C, one or more lengths can be removed as desired. We believe this is a much more logical way of diminishing the drainage tract than by withdrawing the entire drain as is done when larger Penrose tubing with a gauze wick is used for drainage. By removing one or more tubes on successive days, the entire caliber of the drainage tract is reduced without disturbing its depth. Finally when only the last tube remains, the caliber of the drainage tract is so diminished that we believe it will close soon after this remaining tube is removed. In this way we believe the possibility of a collection of pus or fluid remaining in the deep end of the tract is diminished thus lessening the possibility of abscess formation.

We have always thought in using the ordinary cigarette type drain and gradually withdrawing it until it is entirely removed that we leave the deep portion of the drainage tract as a possible pocket for abscess formation and that the drain itself actually serves as a plug in the tract to prevent possible accumulation from draining to the outside. Usually this type of drain is shortened a little each day or two until the entire drain has been removed, as it is usually deemed inadvisable to remove it entirely at one time because of the possibility of leaving a drainage tract of large caliber which might lead to pocketing of pus or fluid. As mentioned previously, by removing one of the tubes of the tube bundle drain each day or two, the entire circumference of the drainage tract is reduced; however, the length of the space is not diminished until the last tube is withdrawn and that can be gradually shortened if so desired.

We have now used this type of surgical drain in a sufficient number of cases to find that it is highly satisfactory and believe it has definite advantages over the ordinary drain.

Case Reports

ADRENAL CORTEX TUMORS*

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THE adrenal gland is derived embryologically from two distinct tissues and is in actuality two separate endocrine entities with different morphology and function. The adrenal cortex arises from the mesoderm of the ventral portion of the celomic epithelium near the urogenital ridge. The adrenal medulla arises from the ectoderm of the sympathetic ganglia cells. The size of the adrenal gland diminishes from being slightly larger than the kidney at the third or fourth month of fetal life to its normal proportion of 1:28 in relation to the adult kidney whose size is attained early in postnatal life.[14]

The protean manifestations of the adrenal cortex in the maintenance of various life processes have been the subjects of numerous reports and investigations. We shall mention only those which are fairly definitely established as the effects of adrenal cortical function, although actually the derangements in the physiology of patients with tumors of this gland are so numerous and so variously interpreted at the present time that it would require considerable space to give a complete account of the subject. Thus we shall touch on only the effects of the adrenal cortex on the metabolism of electrolytes (and thereby the renal function) and carbohydrates and on the secondary sex characteristics.

The most striking effects of an adrenal cortex operation can be seen from the negative viewpoint of the adrenal cortex insufficiency of Addison's disease with the production of dehydration and, ultimately, shock. Hypofunction of the adrenal cortex leads to an excessive loss of sodium and chloride ions from the intracellular fluid, an excessive loss of water and an increase in serum potassium. Extrarenal azotemia is present and hypoglycemic episodes are fairly frequent in these patients.

One would assume then that hyperfunctioning of the adrenal cortex would produce the exact reverse of these effects, that is, retention of salt and water, and hyperglycemia and glycosuria. However, this is not precisely what happens. Apparently, hyperfunction of the cortex has no remarkable effect on the metabolism of sodium, chloride and potassium ions or on the fluid levels of the body. There is apparently no effect on the renal function either, since some edema is often present with adrenal cortical syndromes but in nowhere near the amount which might be expected. Thus the salt-retaining factor of the adrenal cortexhormones seems to be nullified in some way in the hyperfunctioning states of the gland.

Kenyon sums up this whole problem of the effect of adrenal cortical tumors on the metabolism of salt and water in his statement that, "the disposition of these various steroids to enhance one another in some respects, and to cancel one another in other respects, together with the likelihood that tumors may discharge all of these materials and more in varying quantities at various times, makes it entirely reasonable to expect a variety of disturbances in electrolyte balance in those with adrenal neoplasms."[11]

A distinct derangement in the metabolism of carbohydrates is a fairly frequent occurrence in those patients with tumors of the adrenal cortex as proved by the decreased glucose tolerance curves, hyperglycemia and glycosuria. In fact the frequency with which one encounters glycosuria, uncontrollable by the ordinary measures, has led some workers to postulate a linkage between the upset in carbohydrate and protein metabolism caused by dysfunction of the adrenal cortex. It is suggested that there is a varying degree of gluconeogenesis in these patients resulting from a concomitant break-

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down of protein. This has been used as the basis for explanation of a number of the attendant somatic symptoms but is still a subject for considerable speculation and beyond the scope of the present communication.[1]

The clinical changes in the secondary sex characteristics which result from the development of a neoplasm of the adrenal cortex are probably the most striking effect of the disease. Thus the development of virilism in the female adult, of pseudohermaphroditism or sexual precocity in children and, rarely, the development of feminism in the male adult are all observed. Primarily the result of excess secretion of androgens these effects have been definitely related to adrenal cortical hyperfunction. The increased urinary excretion of these hormones has resulted in the development of a number of diagnostic tests to determine whether or not a tumor of the adrenal cortex is present, for example, the biologic and chemical assay of urinary steroids and the colorimetric determination of urinary 28-oxyketosteroids.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of tumors of the adrenal cortex is of extreme importance since the seat of trouble may lie in any one of several endocrine glands. Thus changes due to excess androgens with the production of hirsuties in our case to be described later could be ascribed to an adrenal cortical tumor, a basophil adenoma of the pituitary gland (Cushing's syndrome) or an arrhenoblastoma of the ovary. This diagnostic problem was not particularly acute in our patient, but one must be prepared to make such differentiation if the occasion arises.

The clinical changes in the secondary sex characteristics as described previously are fairly similar in the three syndromes. However, the other symptoms of Cushing's syndrome are well defined ("buffalo" type obesity, abdominal striae, osteoporosity and hypertension) and make this syndrome easier to differentiate from the other two possibilities. Thus we are left with the need of discerning between the presence of an ovarian or adrenal cortical tumor.

In a very young patient with hirsuties, such as in our case, intravenous pyelograms are the first and best aids to differential diagnosis. The pyelogram will show depression of the kidney and a mass lying above. In some cases it will be possible to determine the presence of a mass by palpation.

Air insufflation of the perirenal fascial spaces is also an extremely valuable diagnostic procedure. However, unless absolutely necessary it should be avoided since the procedure can cause shock.

The urinary excretion of hormones may be determined by bio-assay or colorimetric analysis and finally, blood electrolyte and glucose tolerance tests may be used.

OPERATIVE APPROACH

The treatment of choice for tumors of the adrenal cortex is, of course, surgery. There are four possible operative approaches by which removal of such a tumor can be effected, namely, thoracic, lumbar, abdominal and thoraco-abdominal.

The thoracic approach alone is not sufficient in an extensive tumor since the incision is not adequate to allow proper visualization and manipulation of abdominal structures.

The lumbar approach is also inadequate in an extensive tumor lying under the diaphragm as was shown in our case. Again the disadvantages are insufficient room for complete exploration and anatomic dissection of structures. Neither does it permit ligation of the blood vessels before manipulation of the tumor area, a factor which tends to increase the possibility of dissemination of the tumor cells. The disadvantages of this procedure can be lessened somewhat by resection of the eleventh and twelfth ribs, but, generally, even that still does not provide an adequate incision.

The abdominal route is valuable because both the adrenals and all the abdominal structures including the ovaries can be explored. However, here too, with a tumor lying under the diaphragm the incision is not large enough to permit proper visualization.

Thus the thoraco-abdominal route, we think, is ideal in surgery of large adrenal cortical tumors since it gives one the opportunity to explore the entire abdomen and still allows an adequate incision over the tumor area. With the thoraco-abdominal approach the liver can be retracted medially, and a complete visualization and anatomic dissection of structures can be performed. A complete description of the operation will be included in the following report of a case of adrenal cortical tumor with hirsuties in a very young girl.

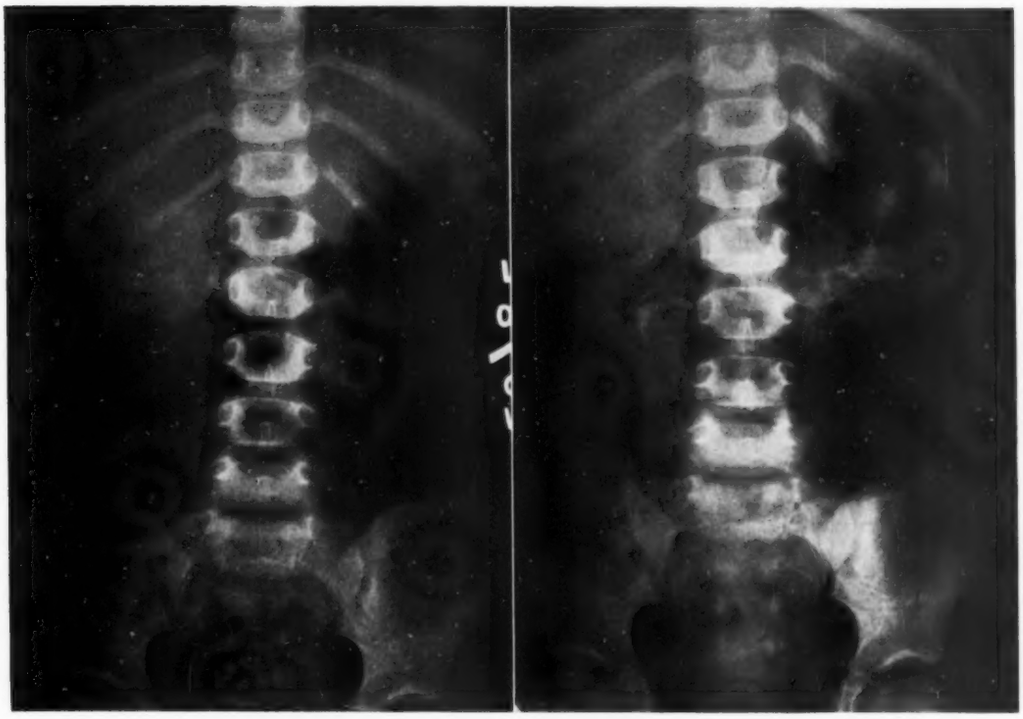

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FIG. 1. Flat plate showing calcification of tumor.

FIG. 2. Intravenous pyelogram showing displacement of kidney and calices, downward.

CASE REPORT

A girl, aged three years, was admitted to the hospital on June 14, 1950. The child had fallen from a height of 4 feet, striking her right loin on the edge of a chair as she fell. The child fainted and the physician who was called sent her to the hospital immediately.

The patient was the youngest of three children and had no previous medical history. The family history was non-contributory.

Physical examination showed a young female child, extremely pale and restless and complaining of pain in the right upper quadrant. The heart was rapid but normal, pulse 160 and feeble, and lungs clear. Respirations were rapid and there was slight air hunger.

Ecchymoses of both loins and marked rigidity and tenderness in the entire right half of the abdomen were observed. A mass was palpated in the right upper quadrant. In addition a fair-sized growth of pubic hairs was present, although the clitoris and vulva were negative.

Results of laboratory examination were as follows: Urine was clear, acid, specific gravity 1.016 and showed a trace of albumin and a rare white blood cell. Blood count revealed hemoglobin 57 gm. per cent; red blood cells, 2,700,000; white blood cells, 26,000; bands 10 per cent; segmented neutrophils 68 per cent; eosinophils 1 per cent; monocytes 1 per cent; and lymphocytes 20 per cent. Smear showed marked hypochromic anemia. The patient's blood type was Rh positive, type O.

Intravenous pyelogram showed good concentration of the dye in the left kidney and normal renal pelvis and ureter. The right kidney was apparently enlarged, the right psoas shadow obliterated and the right renal pelvis was depressed and distorted. Opaque material in the right upper quadrant of the abdomen was visible in the flat plate as well as in the pyelogram. (Figs. 1 and 2.) The impression at this time was tumor of the right adrenal gland with recent hemorrhage. However, rupture of the kidney could not be ruled out.

Accordingly immediate exploration was decided upon. Transfusion was begun and under general anesthesia a right lumbar incision was made. A marked quantity of recent, bright red clots and old clots was encountered in the perirenal fascia. The right kidney was found to be normal and could be separated from the tumor mass above. A biopsy was taken and

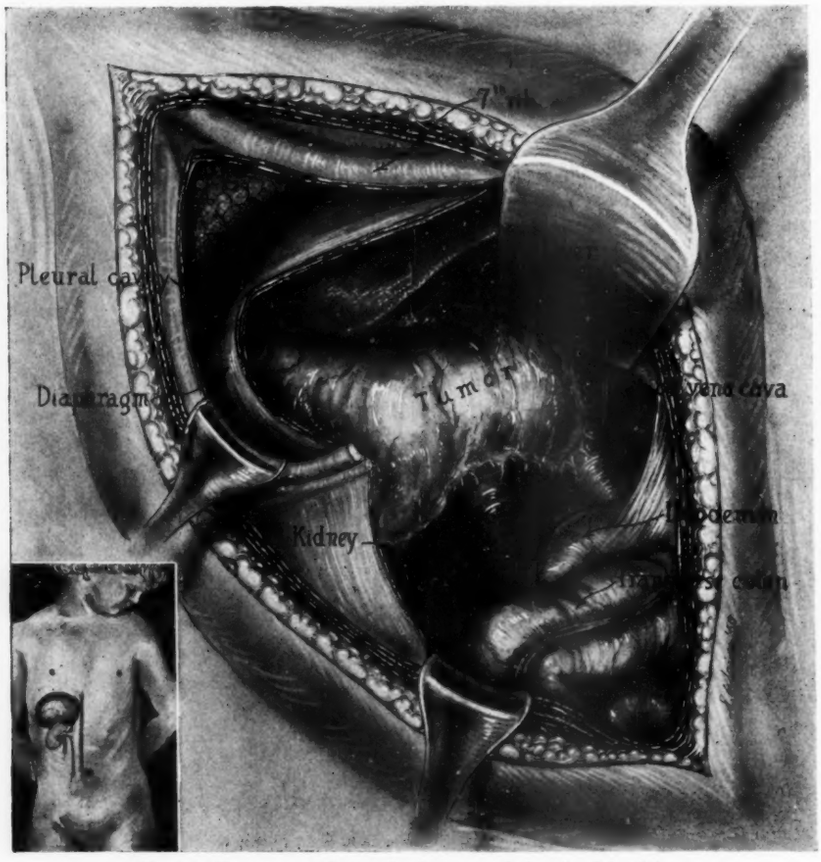

FIG. 3. Exposure through thoraco-abdominal incision.

the area packed with iodoform to control hemorrhage. Since the patient's condition became worse and would not permit further surgery and since the lumbar incision proved to be inadequate for excision of the tumor mass, the incision was closed and the transfusion continued, the patient receiving a total of 1,000 cc. of whole blood. Pathologist's report of the specimen was adenocarcinoma of the cortex of the adrenal gland.

The patient rallied within twenty-four hours. A week later the packing was removed and another transfusion, 250 cc., was given. On June 28th the patient's condition warranted further surgery for removal of the tumor. Prior to operation a cut-down was done on both ankles and under endotracheal anesthesia a thoraco-abdominal procedure was begun. The abdomen was opened by means of an incision over the eighth interspace, beginning at the spine and extending downward and then in a longitudinal direction over the rectus muscle to below the umbilicus. The cartilaginous portion between the eighth and ninth ribs was incised, the diaphragm cut, a rib spreader inserted in the interspace and the pleura opened. The coronary ligaments of the liver were cut and the organ retracted medially. (Fig. 3.)

An incision was made of the tumor on the posterior peritoneum and the kidney was dissected and retracted inferiorly. At this point the renal branch of the adrenal artery entering into the tumor was tied off, and the inferior vena cava and the adrenal vein entering it were also tied off and separated from the tumor. The aortic and phrenic branches of the arterial supply were tied off and the tumor was removed with its surrounding periadrenal fascia. (Fig. 4.)

The diaphragm was then sutured with silk, the chest closed in the usual manner and the abdomen closed with metal alloy, figure-of-eight sutures. The bare area was drained through the lower angle of the incision. Following operation a Levine tube was inserted.

On the first postoperative day the patient's temperature rose to 103°F. and the pulse to 140. However, on the fourth and fifth days after operation the temperature gradually returned to normal.

The pathologic report was as follows:

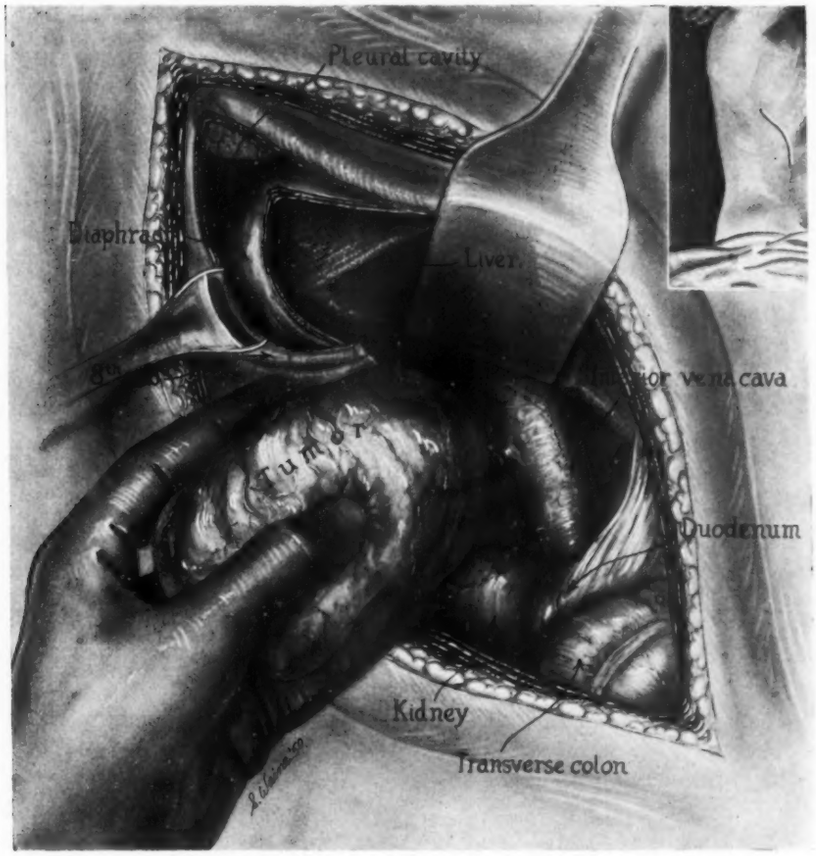

FIG. 4. Incision; operation being completed.

Grossly, the specimen was a rounded mass said to have been removed from the adrenal region. The mass measured 9 by 8.5 by 6 cm. and weighed 206 gm. (Fig. 5.) The tumor was partially encapsulated. The consistency was relatively soft to rubbery. In the cut surfaces the tumor was seen to be composed of nodules of pale to bright yellow tissue. In places there were areas of hemorrhages or liquefaction. Microscopically, section of the tumor showed nests of large, clear cells which arranged themselves above vascular channels. The cells were large and resembled those from the adrenal gland and had abundance of homogenous and clear, pink-staining cytoplasm. The nuclei were bizarre and varied markedly in size, shape and staining reaction. There were giant forms seen in places. Scattered throughout were large areas of necrosis as well as a few small extravasations of blood. In places tumor cells were seen within vascular channels. Early thrombi were also seen within some of these capillaries. Mitotic figures were present. Diagnosis was adenocarcinoma of the cortex of the adrenal gland.

FIG. 5. Illustration of size of tumor.

SUMMARY

The aforementioned comments of the effects of adrenal cortical tumors have been necessarily limited by the extensiveness of the subject. However, we have mentioned briefly the relation of the adrenal cortex to electrolyte and carbohydrate metabolism and to the various changes in secondary sex characteristics which are seen in patients with tumors of this gland

and have described certain diagnostic procedures of value.

Finally a case of tumor of the adrenal cortex in a child of three years has been described.

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SUBCOSTOSTERNAL DIAPHRAGMATIC HERNIA*

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THE coexistence of a subcostosternal hernia and tetralogy of Fallot is rare and is estimated as occurring in less than one in several hundred thousand births. A clinical study of such a case was made. The bizarre symptomatology and the surgical treatment make the case worthy of reporting.

CASE REPORT

A nine month old baby girl was admitted to St. John's Episcopal Hospital in June, 1948, because of vomiting. The mother stated that the infant's lips and nail beds had had a bluish tinge since birth and that frequently while crying her color became more dusky. The child was comparatively well the first six months but then she became reluctant to take feedings which progressed to an aversion to food and finally regurgitation. Irregular periods of air hunger occurred which increased at feeding. Unfavorable symptoms progressed until cyanosis, dyspnea, anorexia, obstipation and regurgitation were pronounced.

Examination on admission showed the patient to be weak, dehydrated and malnourished. Lips, conjunctivas and finger and toenail beds were moderately cyanotic. The rectal temperature was 99°F. and the weight was 14½ pounds. Breath sounds were heard throughout both lung fields except at the anterior basal portion of the right lung where they were diminished. A loud systolic murmur, heard over the pulmonic area, was transmitted to the left axilla. A thrill was present over the precordium during systole. The heart was normal to percussion except for the right border which was difficult to define. The abdomen was slightly distended and protuberant. Tympany was noted on percussion. No masses were palpable.

Chemical analysis revealed a trace of sugar in the urine. The blood count showed erythrocytes 3,820,000, leukocytes 7,500 and hemoglobin 9.1 gm. The differential was normal. A roentgenogram of the chest showed the heart to be slightly displaced to the left, apparently by a mass which occupied the lower half of the right chest. Radiolucent areas suggesting gas-containing viscera were present in the mass. A tentative diagnosis of right subcostosternal diaphragmatic hernia was made. (Fig. 1.)

Surgical repair of the hernia was advised as soon as the baby could be properly prepared. Preoperative measures included gastric lavage with decompression of the stomach, cleansing enemas and the administration of fluids parenterally. The response to treatment was favorable and the infant was considered a fairly good operative risk.

Laparotomy was performed using a right upper rectus incision under open-drop ether anesthesia. Exploration of the abdomen revealed that most of the small intestine, a portion of the transverse colon, the tip of the right lobe of the liver and part of the pancreas were in the chest. The viscera had herniated into the thorax through an opening 3 by 5 cm. in the right diaphram, i.e., through the foramen of Morgagni or the space of Larrey. The first impression was that two hernias were present but careful investigation showed that the aperture was unequally divided by the falciform ligament, the medial space being the smaller.

A hernial sac lined by peritoneum occupied the base of the right chest and the right side of the mediastinum. The sac was drawn into the abdomen and the peritoneum was excised and dissected free so the edges of the hernia could be identified. The falciform ligament was cut anterior to the liver, converting the bisected hernia into a large sac. The mediastinum, the pericardium and the mediastinal aspect of the right pleura could now be identified.

The defect in the diaphragm was repaired by approximating the raw edges of the posterior portion of the opening to the soft tissues on the posterior surface of the anterior chest wall. Interrupted No. 00 silk mattress sutures were placed about 1 cm. apart and tied after a No. 14 catheter was inserted into the space for aspiration of air. The free edges of the peri-

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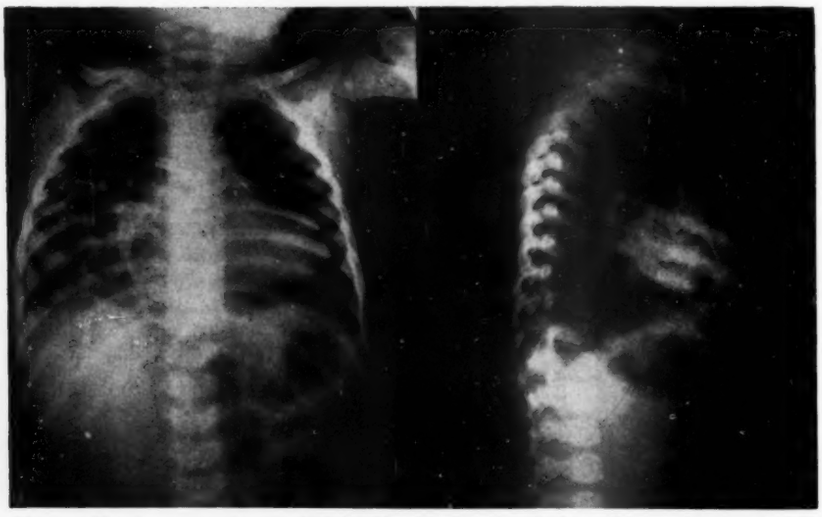

FIG. 1. Postero-anterior and right lateral x-rays of the chest preoperatively; gas-filled viscus in the anterior basal portion of the right chest.

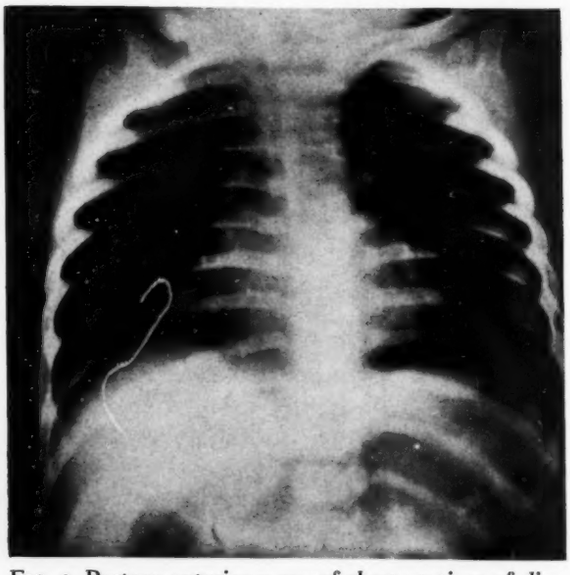

FIG. 2. Postero-anterior x-ray of chest at time of discharge; apex of heart elevated off diaphragm.

toneum and the falciform ligament were brought together buttressing the suture line. The sternocostal chest wall was only slightly depressed following the repair. The phrenic nerve was neither crushed nor interrupted. The abdominal contents were reposited and the air was aspirated from the space in the chest by means of the catheter which was then removed. The abdominal incision was easily closed without tension. A light supportive binder was used to hold the dressing snugly in place.

The patient's convalescence was uneventful. She took water on the first postoperative day and was able to retain a regular diet by the seventh day. During the same period she was given penicillin systemically (50,000 units every three hours) and a blood transfusion (110 cc.). There was no evidence of dyspnea, nausea or vomiting. The temperature reached 101°F. rectally and after the third day it remained normal. Roentgenograms revealed the disappearance of gas-filled viscera, an essentially normal appearance of the lungs and all portions of the diaphragm at normal levels. When the sutures were removed on the twelfth postoperative day, the wound was well healed. The patient was discharged seventeen days after the operation. The systolic murmur was still present in the pulmonic area and the thrill over the precordium continued. A definite tinge of cyanosis was still present in the mucosal surfaces and the nail beds. The cardiac lesion was diagnosed as tetralogy of Fallot. (Fig. 2.)

COMMENTS

A subcostosternal diaphragmatic hernia through the foramen of Morgagni or Larrey's space is believed by many to be congenital. Meyer[6] in reviewing the embryology and the morbid anatomy has pointed out that the diaphragm is susceptible to defects and weak areas from incomplete fusion of the different portions. He states it is a rare type of direct hernia. Parella and Hurwitz[8] believe that the presence of a peritoneal sac suggests that the herniation develops relatively late in the

embryologic development and it may not occur until later when increased intra-abdominal pressure is exerted against a weak area. Harrington[4] mentions the similarity of the hiatal hernia to the subcostosternal hernia in that both have peritoneal sacs and are rarely present at birth. He suggests that the subcostosternal hernias result from weakened areas in the septum transversum which forms the anterior portion of the diaphragm. Donovan[3] states that failure of fusion of the costal and sternal fibers at either side of the sternum results in the foramina of Morgagni.

Murphy[7] reports that in analyzing the congenital malformations in 884 families in Philadelphia some type of anomaly occurred in one of every 213 babies born alive. He also revealed that about 23 per cent of the malformed had multiple deformities. The order of incidence was the nervous system, the gastrointestinal tract, the skeletal structure, and the heart and great vessels. Diaphragmatic malformations made up less than 1 per cent of all anomalies. Taussig[10] states that in congenital heart disease a high incidence of spinal abnormalities occur but she does not mention the occurrence of diaphragmatic hernias.

Harrington[4] reported a series of 404 cases of diaphragmatic hernias, only eight of which were the subcostosternal type. Two cases of bilateral subcostosternal hernias in a series of seventeen diaphragmatic hernias were reported by Donovan.[3] Parrella and Hurwitz[8] recorded an interesting case of a twenty-nine year old veteran in whom the hernial sac was not removed from the chest. They reported no recurrence. DeNicola and Uracin[2] recorded the case of a two year old boy with alarming pulmonary symptoms. The hernia was successfully repaired. Johnson[5] reported the case of a twenty-six year old chronically ill woman in whom roentgenograms demonstrated a subcostosternal hernia. A successful repair was accomplished. No cardiac condition or anomalies were mentioned in any of these case reports.

Careful study of the roentgenograms may reveal the typical roentgenologic findings of a subcostosternal hernia as reported by Ritvo and Peterson.[9] DeNicola and Uracin[2] point out in their case the importance of following the barium meal through the intestinal tract. At times the defect in the diaphragm can be clearly outlined by the loops of bowels. Clay and Hanlon[1] illustrated the diagnostic value of pneumoperitoneum in differentiating lesions often associated with the diaphragm.

Recognition of the multiple congenital anomalies is vital in the preparation of the patient for surgery. The decompression of the gastrointestinal tract is self-evident and should be done just before the operation. Other preparations are the combatting of dehydration, adjusting electrolytes and acid-base balance, and the liberal use of oxygen.

Surgical repair of the subcostosternal hernia should be transabdominally to affect good closure of the defect. A right rectus approach gives good exposure, but the advantage of a transverse incision which may extend across the costal arch into the thorax making a combined approach is worthy of considering.

The smaller subcostosternal hernial defects may be repaired by approximation with mattress sutures. This procedure will suffice in most cases. Harrington[4] mentions the use of living fascial suture held in place by silk sutures. In larger defects the soft tissues may be mobilized from the anterior chest wall for repair. Parrella and Hurwitz[8] report the use of a living fibromuscular flap from the transverse fascia.

The adjustment of intra-abdominal pressures after the repair of the hernia varies with the volume of the sac and the tenseness of the abdominal wall. Excessive pressure will elevate the diaphragms so as to prevent adequate ventilation of the lungs and force much of the blood of the viscera into the peripheral circulation overloading the heart and inducing pulmonary edema. If necessary the pressure may be reduced by creating an incisional hernia which can be repaired later. The phrenic nerve should not be interrupted as the diaphragmatic motion that is necessary for pulmonary ventilation must be maintained to counterbalance any increase of intra-abdominal pressure.

SUMMARY

1. A case of a subcostosternal diaphragmatic hernia with coexisting tetralogy of Fallot is reported. This incidence is rare.

2. The diagnosis of such a hernia may be established by the roentgenologic findings of a thoracic mass, the course of the barium meal and the relationship of pneumothorax or pneumoperitoneum to the density.

3. The surgical approach and the methods of repair of the hernia have been discussed.

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Patients with acute pancreatitis can be helped if food is restricted by mouth and glucose intake is greatly diminished because this tends to put the pancreas at rest. Pancreatic secretions can be further diminished if the patient is given banthine. In dogs surgical vagotomy produces an even better result since this operation reduces the volume and amylase content of pancreatic secretion by as much as 50 per cent whereas with banthine this reduction is only about 20 per cent. Banthine administration surely seems justified in patients afflicted with acute pancreatitis. (*Richard A. Leonardo, M.D.*)

TRICHINOSIS COMPLICATING PREGNANCY*

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PYREXIA during labor and the early postpartum period is a frequent occurrence and occasionally may be a prelude to a serious obstetric complication. The obstetrician is prone to consider lightly a slight elevation in temperature because many times the common cold, laryngitis or lesser infectious conditions may be the source. One must not fail to consider such frequent and oftentimes serious obstetric complications as: amnionitis, cystitis, pyelitis, dehydration, phlebitis and puerperal sepsis. If one keeps in mind the more common complications, he is apt to recognize the unusual conditions causing pyrexia. Some of those to be considered are acute and subacute bacterial endocarditis, malaria, leukemia and Hodgkin's disease. Recently we were confronted with a case of trichinosis which complicated pregnancy at term, the outstanding symptom being merely an elevated temperature.

Human trichinosis in itself is an interesting and infrequent condition but it is a rare complication in pregnancy. It is an acute condition caused by the Trichinella spiralis acquired by ingestion of infected meat. The disease is characterized by remittant fever, edema of the face, pain and soreness in the muscles, and emaciation. It is difficult to determine the prevalence of trichinosis because the mild cases do not receive medical attention; others are not recorded and still others are left undiagnosed. In an unselected series of autopsies 20 per cent were found to possess trichinosis in the diaphragm. Of course, only rarely, was the T. spiralis abundant enough to give clinical symptoms. After infected meat is eaten, the cyst wall of the trichinella is digested in the stomach and the worm is liberated, and thus passes into the small intestine. There it grows to maturity in two to three days. The female is then fertilized and about the seventh day it penetrates into the mucosa of the intestine. The embryo then escapes and lodges in the tissues of the small intestine, thence it proceeds into the lymph spaces of the mucosa and submucosa. The embryos are delivered over a period of about six weeks. From the lymph spaces the embryo is found in the muscle on about the tenth day; here it grows rapidly and completes its development in fifteen days. Then about one month after the infection begins it proceeds to coil and encyst. It may continue to live for twenty to thirty years.

A clinical condition of gastrointestinal disturbance, edema of the face, especially the eyelids, with pain, hardness, rigidity and contractures of the muscles and loss of tendon reflexes should lead one to suspect trichinosis. A leukocytosis of 25 to 30,000 white blood cells and an eosinophilia of 15 to 30 per cent will help to substantiate the diagnosis. A precipitin test for trichinosis will be positive in about 65 per cent of the cases. A positive diagnosis can only be made by a muscle biopsy demonstrating the T. spiralis.

CASE REPORT

This twenty-three year old white woman, gravida II, para I, entered the hospital in active labor with contractions every twelve minutes. On admission her temperature was 103.2°F., orally. She complained of a generalized aching feeling accompanied with fever and chills for the past week. The family physician treated her with aspirin and codeine sulfate for a catarrhal fever. At the time of admission we concurred with the family physician's diagnosis and treated her with penicillin and aspirin. The routine physical examination was normal. Six hours after admission to the hospital, she delivered spontaneously a viable female infant under drop ether anesthesia. Blood loss was moderate. The mother and baby left the delivery room in satisfactory condition, except for a slight sinus arrhythmia noted during delivery by the anesthetist.

During the first and second postpartum days the patient continued to run an elevated temperature which ranged from 100° to 103°F. This was accompanied with periodic bouts of sweating occurring at any time of the day or night. It was found that the cervical, axillary and

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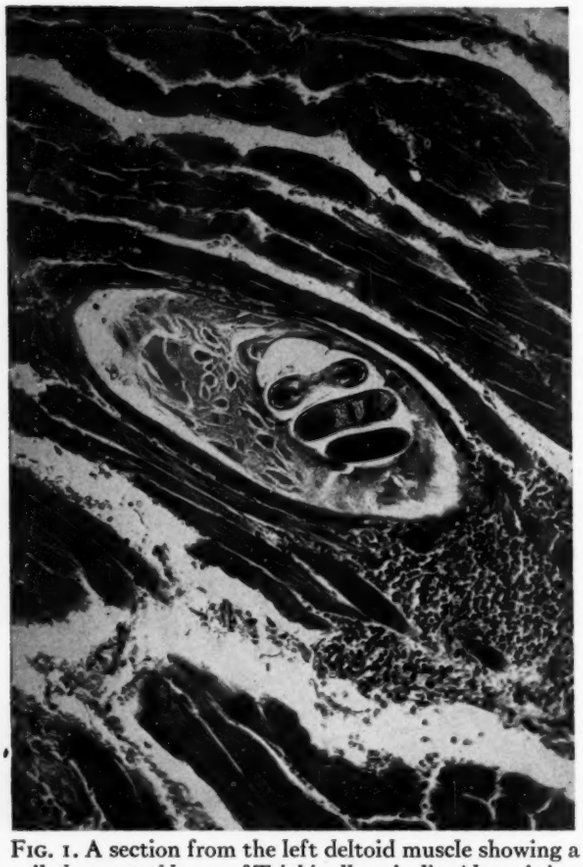

FIG. 1. A section from the left deltoid muscle showing a coiled encysted larva of Trichinella spiralis. About it is a marked inflammatory infiltration of polymorphonuclear leukocytes and lymphoid cells.

inguinal lymph nodes were enlarged to about the size of a pea. A white blood count at this time showed a leukocytosis of 22,300 with 55 per cent eosinophilia. Upon further examination and questioning of the patient it was revealed she had noted a puffiness of her eyes approximately one week prior to admission to the hospital. She also admitted having eaten some homemade pork sausage approximately three weeks prior to admission but claimed that the sausage was thoroughly boiled.

On the third postpartum day she began to complain of generalized muscular pain with continued bouts of sweating and elevation of temperature. The impression at this time was trichinosis. A medical consultant concurred with this diagnosis.

The following day a skin test was done; this proved to be negative. On the sixth postpartum day the temperature continued at 102°F. and the white count was 16,000 with 62 per cent eosinophiles. The baby's blood count was normal.

On the tenth day the temperature was still elevated and the patient complained of pain in the muscles of the neck, arms and chest. The second skin test was also negative.

On the thirteenth day a microscopic diagnosis of trichinosis was made from a deltoid muscle biopsy. The pathologic report was as follows: Section of muscle from the left arm showed a coiled encysted larva of T. spiralis. About it was a marked inflammatory cell infiltration of polymorphonuclear leukocytes and lymphoid cells. Several other smaller focal collections of the same inflammatory cells were seen, but no larva was present in their immediate vicinity. Diagnosis was trichinosis of the muscle (arm). (Fig. 1.)

Other laboratory data was as follows: X-ray of the chest revealed a possible mitral lesion; electrocardiogram was normal; serology negative; blood type, O Rh positive; sedimentation rate 14 mm.; urinalysis cloudy amber, specific gravity 1,029; acid; sugar trace; albumin trace. Microscopically, there were occasional granular and occasional hyaline casts with a few white and red blood cells. The treatment throughout the patient's hospital stay was supportive. On discharge she was symptom-free and apparently well. Her white blood count at this time was 12,700 with 35 per cent eosinophiles. The baby left the same day in apparently good health, the white count being 7,300 with 2 per cent eosinophiles.

SUMMARY

In the foregoing comments we have emphasized the importance of establishing a definite diagnosis when pyrexia of late pregnancy occurs. A low grade temperature usually does not forewarn of a serious obstetric complication but one must not be lulled into a sense of false security. We have presented a patient, Mrs. D. O., gravida 11, para 1, who entered the hospital in active labor with a temperature of 103°F. A diagnosis of catarrhal fever was made and appropriate treatment followed. The labor was not further complicated. The postpartum course did not improve and subsequently trichinosis was suspected; this was substantiated by muscle biopsy. The possibility of transferring the T. spiralis from mother to child interested us.

Augustine, Staubli, Pavlica, Belding, Catron and Hooker have reported that in rats, rabbits, swine, cats and guinea pigs there is no apparent

transfer of T. spiralis from mother to fetus. After reviewing the literature similar results were found in the four cases reported in men. Mrs. D. O. delivered spontaneously a healthy normal female who progressed uneventfully while in the hospital. Two blood counts did not reveal an elevated eosinophilia. At five weeks of age the infant was still symptom-free, the eosinophile count was normal and skin test was negative. We therefore believe there was no transfer of T. spiralis in this case.

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URACHAL CYSTS AND THEIR COMPLICATIONS

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URACHAL cysts, especially those accompanied with complications, are of sufficient rarity to warrant this report of two cases observed within the past few years. These developmental defects are not particularly uncommon but seldom, if ever, are they brought to the attention of the physician until drainage from the umbilicus occurs or an inflammatory mass appears at the umbilicus, or somewhere between the umbilicus and the dome of the urinary bladder.

In embryonic life the allantois is a component of the umbilical cord, forming a direct connection between the placenta and the cloaca; the latter structure later becomes divided; that portion to which the allantois is attached forms the urinary bladder; the allantois becomes obliterated and is then known as the urachus. Some writers[1] hold that this structure remains more or less patent and lined with epithelium, which may account for the foul-smelling discharge from the navel, usually the symptom which brings the patient to the physician. Vaughan (quoted by Herbst[2]) classified urachal anomalies as follows: (1) the duct being completely patent between bladder and navel; (2) the blind internal, that is, the navel remaining closed, the duct communicating with the bladder; (3) the blind external, the bladder being closed, the duct communicating with the navel; and (4) the blind, both ends being closed and the middle remaining open.

SYMPTOMATOLOGY AND DIAGNOSIS

Herbst,[2] in an exhaustive study of patent urachus, collected one hundred forty-eight cases which had been reported from 1550 to 1937 and found that the predominant symptom was an umbilical tumor mass. Next in frequency was discharge from the umbilicus; this is usually thick, mucopurulent and offensive and in certain classes of individuals is often mistakenly diagnosed as an inflammatory condition resulting from uncleanliness. In some cases the mass reaches such proportions that it may be taken for an ovarian cyst or in the instance of Sawyer's[3] case, in which there was a connection with the descending colon, it was thought to represent a large diverticulum. The urachal cyst without infection usually presents no symptoms and is evidenced only by the tumor mass; infection, however, or blockage of the umbilical opening leads to extension of the mass along fascial planes and those phenomena associated with inflammatory masses elsewhere, for example, pain, tenderness, local heat and redness, chills, fever, leukocytosis and, if connected with the bladder, pyuria and cystitis.

TREATMENT

Treatment is entirely surgical, but before excision is decided upon it is imperative that it be determined which type of urachal anomaly one is dealing with, whether this is a blind cyst or whether it connects with bowel or bladder. In numerous early case reports cited by Herbst[2] the treatment in infants was ligation and/or compression of the umbilical mass, frequently with recurrence. In all cases cystoscopy should be carried out previous to surgery.

Excision of the tract or cyst is the method of choice, although in one of the two cases herein reported it was deemed advisable, due to the exigencies of war, to treat the cyst by marsupialization in much the same manner of the Buie exteriorization of pilonidal cyst. In excising the cyst it is desirable to avoid entering the peritoneal cavity; but if the involvement is extensive, it is usually necessary to do so.

CASE REPORTS

CASE 1. J. J., a white male, officer, age twenty-seven, entered the Barnes General Hospital September 1, 1941, because of a discharge from the umbilicus which had been present for three weeks; associated with the discharge were pain, tenderness and an inflammatory periumbilical mass and swelling extending downward from the umbilicus for a distance of 2 inches. Upon close questioning he denied having previously experienced any discharge from the umbilicus. He recently had been on maneuvers during which time sanitary

conditions had been very undesirable and bathing facilities practically nil.

Previous medical history revealed the usual common childhood diseases and otherwise nothing of importance relative to the present condition.

right lower abdominal quadrant, fever, pyuria and drainage from the umbilicus. This mass had first appeared in 1944 and was thought to be an incisional hernia as a result of an appendectomy performed in 1941. In 1948 the patient had a bout of fever pyuria, hematuria

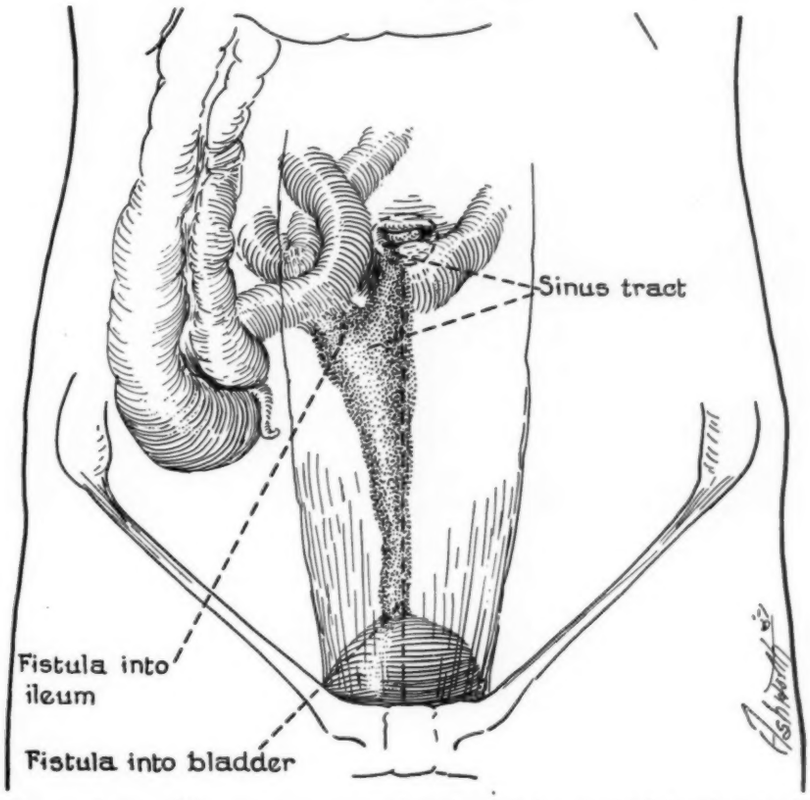

FIG. 1. Case II. Schematic representation of urachal cyst which involves both bladder and ileum.

A diagnosis of infected urachal cyst was made and urologic consultation was requested which resulted in a completely negative survey. A sinus opening at the umbilicus was probed for a distance of 4 cm. resulting in foul-smelling purulent material which upon culture revealed Staphylococcus aureus. Hot packs and repeated probing resulted in diminution of the mass and subsidence of the acute cellulitis. On September 15th the mass was incised in its entire length and was found to consist of a pouch about 1 cm. in diameter and extending downward from the umbilicus a distance of 4.5 cm. This was treated by curettage and packing. The wound healed by granulation and epithelization within two weeks and the officer was returned to duty.

CASE II. In 1949 H. S., a white man, age forty-one years, complained of a mass in the

and weight loss. This chain of events recurred several times during 1948 and 1949 previous to his coming under my observation and on several occasions he stated he passed gas by urethra and more lately through the umbilical sinus.

Examination on December 14, 1949, showed an emaciated white man obviously quite ill, weighing 112 pounds. He was alert and cooperative. Examination of head, neck and chest was normal. The abdomen was scaphoid, revealing an old, right rectus scar and a draining sinus of the umbilicus surrounded by a zone of cellulitis. There was a mass approximately 4 by 9 cm. extending from the umbilicus downward and beneath the right rectus muscle, which mass was attached to the abdominal wall proper and moderately tender. No other mass or organs were palpable. Rectal exami-

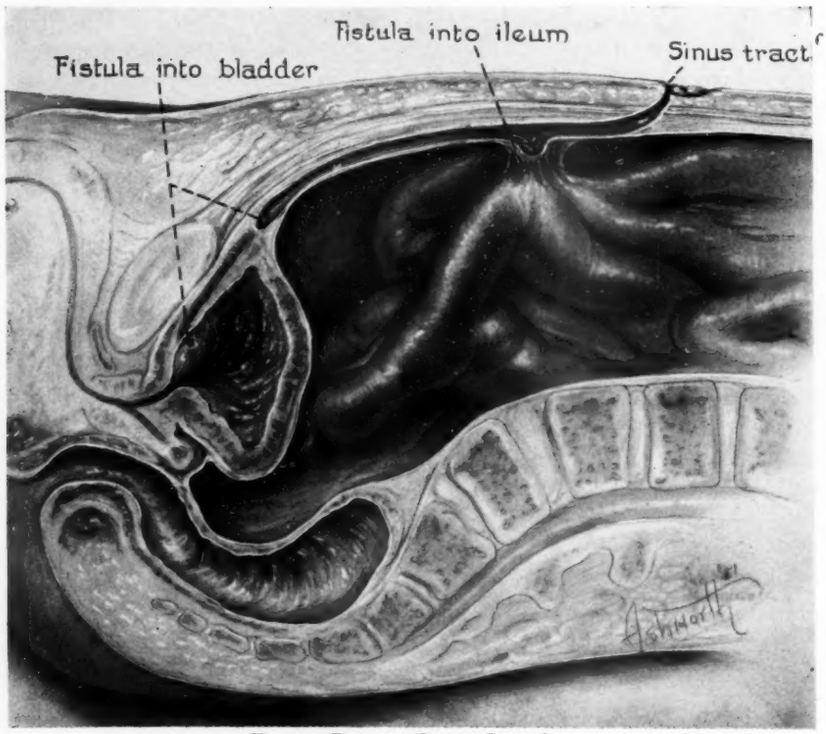

FIG. 2. Case II. Coronal section.

nation was normal. Temperature was 100°F., pulse 90, respirations 20. Examination of the blood showed erythrocytes 4,520,000 per cu. mm., hemoglobin 13.0 gm. per cent, leukocytes 17,250 per cu. mm., small lymphocytes 14 per cent, neutrophiles 71 per cent, staff cells 15 per cent, sedimentation rate 5/54. The urine showed a trace of albumin and a centrifuged specimen was packed with pus cells and motile bacteria. Urine culture resulted in a heavy growth of Escherichia coli; culture of drainage from an umbilical sinus also resulted in a growth of the same organism.

A cystogram was made on December 21, 1949, which did not reveal a "connection between the bladder and any opening which could be classified as a urachus." "There were some irregularities in the surface of the dome of the bladder compatible with inflammatory changes."

The sinus was injected with sodium iodide and was found to spread out in a wide irregular manner deep within the right lower abdominal quadrant over an area 10 to 12 cm. in different directions. A diagnosis of urachal cyst with probable communication with bowel and bladder was made. (Figs. 1 and 2.)

Operation was performed on December 28, 1949. A ureteral catheter was first inserted into the umbilical sinus, 5 cc. of methylene blue injected and the catheter left in place. An incision was made around the umbilicus to excise this area and extending down to the symphysis pubis. Upon incising the deep fascia a cord-like mass was revealed extending from umbilicus to bladder. Great difficulty was encountered in dissecting this structure because of surrounding inflammatory reaction. The peritoneum was incised to the left of the midline and the mass was found to be adherent to several loops of ileum with an apparent sinus tract into one loop. Further dissection proved that the mass extended downward over the anterior wall of the bladder and a cord-like structure was attached at the dome. The sinus tract continued downward into the space of Retzius at which point it was detached from the bladder wall releasing a quantity of methylene blue. The bladder wall was repaired and at the advice of Dr. Robert Fitzgerald a large Pezzar catheter was sutured into the bladder. The mass was then reflected upward and detached from the terminal ileum leaving a defect in the bowel which also contained methylene blue. Repair of this defect resulted in such a narrowing of the lumen it was deemed advisable to establish an ileocecostomy around the mass of adherent, thickened loops of terminal ileum

rather than subject the patient to resection in the face of his then rather poor condition. A cecostomy tube was brought out through a stab wound. Careful closure was accomplished with catgut throughout. (Fig. 3.)

This patient's convalescence was completely without incident. Dr. Fitzgerald supervised the care of the bladder for a few days and removed the catheter on the fifth day at which time the patient voided clear urine spontaneously. The cecostomy tube was removed on the eighth day at which time the patient was having normal bowel movements. He was discharged from the hospital on the fourteenth day after operation in excellent condition.

One year after operation he had gained 40 pounds in weight and was completely free from any symptoms referable to bowel or bladder. Blood and urine examinations were normal.

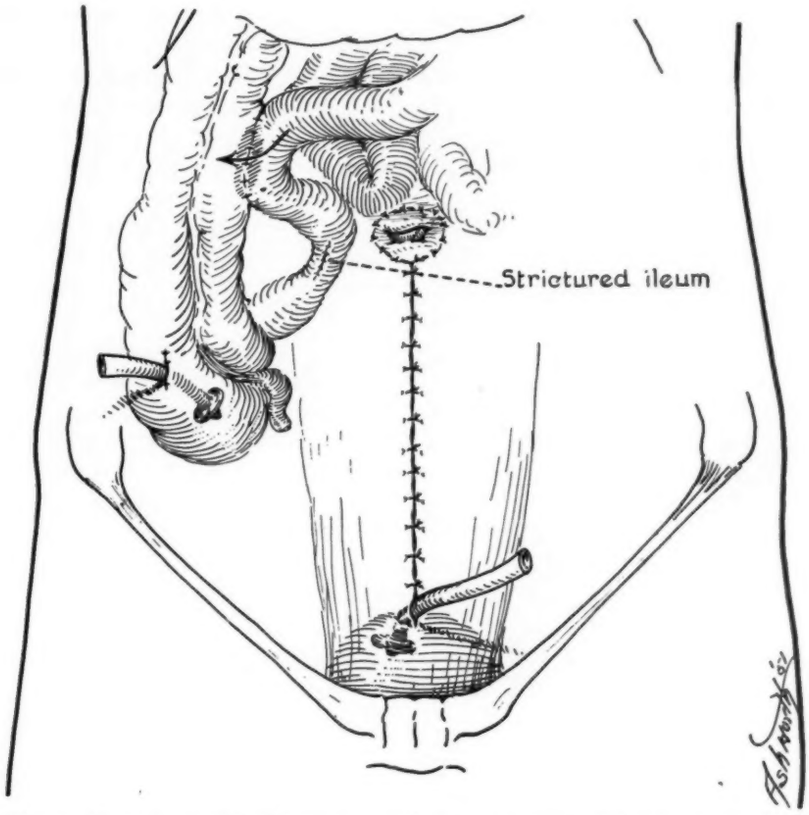

FIG. 3. Case 11. Cyst has been resected; note anastomosis between terminal ileum and ascending colon because of strictured ileum.

COMMENTS

The first case herein reported conforms to the so-called "blind external" cyst described by Vaughan and can be very easily cured by exteriorization or marsupialization and simple packing. The second case represents the completely open urachus complicated by communication with the bowel and bladder and with abscess formation. It is difficult to explain why repeated attempts to demonstrate a communication between the bladder and cyst failed unless some sort of valve-like fold existed at the point of entrance. In this type of case it is believed that resection *en bloc* without opening into the sinus is the operation of choice. It is extremely important that the bladder be given a great deal of care both before and after operation and that antibiotics be used freely.

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PELVIC PHANTOM TUMORS*

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THERE is no more distressing situation in obstetric and gynecologic diagnosis than to inform a patient that she is afflicted with a tumor which on further investigation can no longer be found. This is too often the result of palpating a pelvic phantom tumor. Phantom tumors are the evanescent appearing and disappearing pelvic tumors, usually cystic in consistency, arising from the intestinal tract. This term is not intended to refer to inflammatory pelvic processes as pyosalpinx, nor to figments of the imagination, but to a definite structural entity that is not a pelvic disorder.

Although this term is commonly used by obstetricians and gynecologists, a recent search of the literature by the staff of the New York State Medical Library failed to reveal publications on this topic by any other source for the last twenty-five years. However, in 1929, A. J. Fleischer describes a case of intestinal obstruction simulating a twisted ovarian cyst.

Pelvic phantom tumors are an accepted diagnosis described in the Standard Nomenclature of Disease. Yet the commonly accepted usage of the term differs from its description in the Standard Nomenclature of Disease. In this volume phantom tumors are included under the diagnosis of hysteria and malingerer.

It is therefore necessary to define the term pelvic phantom tumors as produced by anomalies or full loops of almost any part of the intestine, especially the upper rectum, rectosigmoid or cecum. Pelvic phantom tumors are not felt by the patient and, therefore, cannot be classified under the diagnosis of malingerer or hysteria. They are palpable to the examining doctor only. The phantom tumor is a mass palpable on occasions by the examiner, and at times not present on palpation, but so reappearing on repeated examinations as to convince the examiner that a pelvic pathologic disorder exists. It is not constant in its appearance only because at times it eludes the examining finger. The diagnosis of a phantom tumor is made only after entering the abdominal cavity and finding no disorder or a distended or redundant loop of intestine. The common denominator for these pelvic phantom tumors is the fact that they are usually inconsistent in their appearance on examination because of the emptying and filling of the pelvically palpable loop of intestine.

It is suggested (M. J. G.) that this term should be restricted to the evanescent pelvic masses whose origin is intestinal only, as this category is the one which creates most of the diagnostic difficulties in the realm of the gynecologic examination. The following conditions are therefore not included in the definition of phantom tumors but may simulate them: (1) Ovarian cysts which later are absorbed or rupture. Repeated pelvic examinations with at least one examination after a menstrual period helps to diagnose this condition. (2) A full or incompletely emptied urinary bladder and bladder diverticuli. This diagnosis may be ruled out by simply having the patient void or catheterizing her. (3) Tumors on long pedicles which may arise in the genital pelvic organs, bowels, omentum and mesentery. These may drop in or float out of the pelvis. In the identification of these conditions one would not only employ repeated pelvic examinations (with bladder and rectum empty) and cystoscopy, but also x-ray (barium enema) and culdoscopic examination.

It was decided to review the records of the Morrisania City and Lebanon Hospitals. Phantom tumors of the ovary are accepted as a fact, yet search of the records in both institutions showed that there were no cases recorded for this diagnosis. At Lebanon Hospital the records were searched from the time of the opening of the new building in 1946 until July 25, 1950, and at Morrisania City Hospital the records were searched from December 30, 1945, until September 30, 1950. All cases of undiagnosed pelvic disease were also reviewed. In the 5,326 admissions on the gynecologic service of Morrisania City Hospital only two cases of pelvic phantom tumors were found.

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CASE REPORTS

CASE I. F. M., a thirty-six year old, colored, married woman, was admitted to Morrisania City Hospital on October 8, 1948, with a history of sudden onset of pain in the right lower quadrant of the abdomen of twenty hours' duration. On this morning there was an onset of vaginal bleeding

Family and medical histories were non-contributory. The patient was a grava II, para I. Onset of menses at fifteen years, appeared every twenty-eight days and lasted for three to four days. Her last menstrual period began September 15, 1948. In 1939 the patient was operated upon for a right ectopic gestation. In 1943 she had a full term, normal spontaneous delivery.

On admission to the hospital temperature was 98.6°F., pulse 96, respirations 22 and blood pressure was normal. There was no previous history of any of the pelvic inflammatory diseases. Abdominal examination by a member of the attending staff revealed a positive right Murphy sign. There was marked tenderness in the right lower quadrant of the abdomen in addition to rebound tenderness. Rigidity was present over this area. Vaginal examination revealed a clean cervix with no lesions and bleeding was present from the external os. Uterus was retrocessed, anteflexed, normal in size and fixed. Marked tenderness was present on motion of the cervix and uterus. The right adnexa showed tenderness with a "softish thickening" at the cornual end of the uterus. The left adnexa was negative. No doughy feel was present in the cul-de-sac. Diagnosis of ectopic pregnancy was made.

White blood count was 14,200: polymorphonuclears 76 per cent, transitionals 3 per cent, lymphoytes 21 per cent, monocytes 2 per cent, eosinophiles 1 per cent and hemoglobin 11.2 gm. per cent. ESR was 1 mm. in thirty minutes. Urine test was negative.

Laparotomy was done the same day and the following was found: (1) left tube and ovary normal; (2) right tube missing; (3) attenuated right infundibulo, pelvic ligament; (4) dilated large intestine; (5) bound down, but normal appendix; and (6) slightly enlarged uterus with several subserous fibroids.

On October 15, 1948, because no cause for the right lower quadrant pain was discovered at laparotomy, a request for nuerologic consultation was made; yet no objective signs of focal neurologic disease was found on examination.

Postoperative course was uneventful. Mazzini test was reported negative and the patient was discharged on the twelfth postoperative day apparently asymptomatic. Although the etiology of this condition is not clear-cut, the distention of the large bowel was so marked at laparotomy that it aroused comments from several of the physicians present.

CASE II. R. K., twenty-six year old, white, single woman, was admitted to Morrisania City Hospital on June 9, 1942, with a pain in the left lower quadrant of the abdomen of three weeks duration. Pain was worse on standing.

Family and medical histories were non-contributory. The patient was a grava 0. Onset of menses was at fifteen and a half years, appeared very irregularly, and lasted for four days. The last menstrual period was in the last week of May, 1942. An appendectomy was done eight years ago at Morrisania City Hospital and it was at that time that the patient was told she had cysts of one or both ovaries.

On admission, temperature was 99.0°F., pulse 96, respiration 18 and blood pressure 120/80. Rectal examination done about June 15th showed normal size and freely movable uterus. Cervix was smooth and hard and a mass could be felt in the left lower abdomen by combined rectal and abdominal hand which is suggestive of an ovarian cyst. A retrograde pyelogram showed normal pelves, calyces and ureters, and barium enema done on June 19th was negative for the rectal and intestinal studies.

On June 16th the red blood count was 4,300,000 and the white blood count 8,600. Hemoglobin was 85 per cent, polymorphonuclears 39 per cent, lymphocytes 52 per cent, monocytes 4 per cent, eosinophiles 4 per cent and basophils 1 per cent. Urine culture on June 12th showed no growth after forty-eight hours. Kahn test was negative. Phenosulfonphthalein output was 75 per cent, urea nitrogen 15.9 mg. per cent and blood sugar 91 mg. per cent. Urine analysis on June 15th was within normal range. ESR was 8 mm. in one hour.

On June 18, 1942 because of radiation of the pain to the back a neurologic consultation was ordered. He reported that patient had evidence of chronic back strain but no neurologic involvement.

On June 30th a laparotomy was done for an ovarian cyst. The operative findings showed the

uterus normal and the left adnexa was normal except for a few small cysts on the surface of the ovary, the largest of which was 1½ cm. in diameter. This was excised and the ovary sutured. Exploration on the right side revealed a thick adhesive band 4 cm. in length between the cecum and right lateral parietal peritoneum; this was severed. Postoperative course of the patient was uneventful and she was sent home on July 13, 1942.

SUMMARY

A pelvic phantom tumor is defined as a mass which a physician palpates and misinterprets for a pelvic disorder. Eventually, because of the patient's complaints of pain and repeatedly finding the palpable mass he opens the abdominal cavity to find no pathologic disorder but only a distended or redundant loop of intestine.

If any attempt is to be made to get more information on pelvic phantom tumors, it is necessary for physicians to use greater accuracy in recording this diagnosis. Else these cases are classified as either undiagnosed disease or lost under the category of a secondary condition that may coexist in the patient. If a larger series of these cases of missed diagnoses could be collected, further ways and means of making the diagnosis and preventing unnecessary surgery may be found.

Acknowledgment: We wish to acknowledge with appreciation the assistance of the record room staffs at both Morrisania City and Lebanon Hospitals in obtaining data for this article.

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1. Fox, C. L. Jr., et. al.: An Electrolyte Solution Approximating Plasma Concentrations with Increased Potassium for Routine Fluid and Electrolyte Replacement, J. A. M. A., March 8, 1952.

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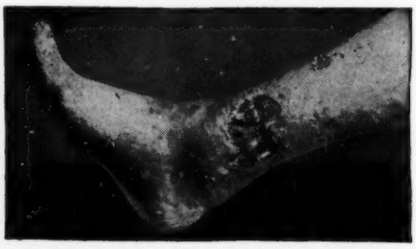

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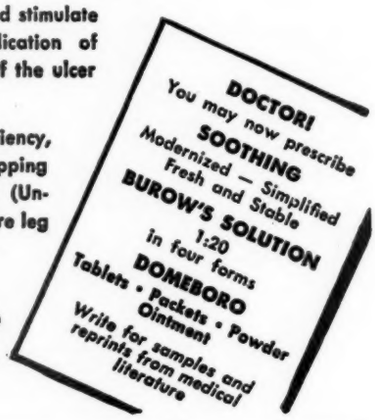

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RADIOACTIVE cortisone for use in medical research will be manufactured with the aid of funds from the National Institute of Arthritis and Metabolic Diseases, Dr. Russell M. Wilder, Director of the Institute, recently announced. The Institute is under the supervision of the Public Health Service of the Federal Security Agency.

"Radiocortisone will be a valuable tool for scientists," said Dr. Wilder, "particularly those studying arthritis and the various metabolic diseases involving adrenal gland hormones. Further knowledge of these hormones might benefit the 7,500,000 Americans who suffer from rheumatic disease."

The radioactive cortisone has not been produced hitherto in sufficient quantity for research studies. It will contain radioactive carbon. This will "tag" the cortisone so that it can be traced through the bodies of experimental animals to learn how it produces its effects in health and disease. How cortisone acts to give dramatic relief to arthritis sufferers is still a mystery of science. Tracer studies with the radioactive product may help solve it.

THE National Gastroenterological Association announces that its Fourth Annual Course in Postgraduate Gastroenterology will be given at the Hotel Statler in New York City October 23–25, 1952.

As in past years the course will again be under the direction and co-chairmanship of Dr. Owen H. Wangensteen, Professor of Surgery of the University of Minnesota Medical School, who will serve as surgical coordinator and Dr. I. Snapper, Director of Medical Education of The Mt. Sinai Hospital, New York City, who will serve as medical coordinator.

Drs. Wangensteen and Snapper will be assisted by a distinguished faculty selected from the medical schools in and around New York City whose presentations will cover diseases of the mouth, esophagus, stomach, pancreas, psychosomatic aspects of gastrointestinal disease, diseases of the liver and gallbladder, pancreas and spleen, colon and rectum from the medical as well as surgical aspects, and other miscellaneous subjects including pathology, physiology, radiology and gastroscopy.

One complete session will be devoted to a clinicopathologic conference at the Mt. Sinai Hospital. For further information and enrollment write to the National Gastroenterological Association, Department GSJ, 1819 Broadway, New York 23, N. Y.

MORE than 600 universities, hospitals and research laboratories in forty-six states are using isotopes produced by the U. S. Atomic Energy Commission for medical, biologic, industrial, agricultural and scientific research and medical diagnosis and treatment, the Commission stated in a published report.

The report, "Isotopes—A Five Year Summary of U. S. Distribution," is available to the public from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for $1.00 per copy. A summary of isotope applications considered to be of significance to industry has been compiled from the Five Year Summary and printed separately as document TID-5078 available at the Office of Technical Services, Department of Commerce, Washington 25, D. C., for 30 cents per copy.

A CLEARINGHOUSE service on *competent* editorial assistants or collaborators to assist in the preparation of papers for meetings, publication or clinical demonstrations is being established. Technicians qualified to assist in editing explanatory or sound tract material in conjunction with professional motion pictures are included. Information will be available to *all* members of the medical profession on request.

The reader can assist this new service by forwarding names and addresses of qualified collaborators to Academy-International of Medicine, 214 West Sixth St., Topeka, Kansas.

THE chemical structure of a recognized growth factor which is needed by many micro-organisms is described for the first time in the *Journal of the American Chemical Society*. Research workers at Lederle Laboratories here solved the molecular structure and synthesis of what has been named "thioctic acid."

The growth factor, originally termed "Protogen," was first described by Professor G. W. Kidder and Dr. Virginia Dewey of Amherst College in 1944, and since then there has been a heated race among a number of research teams to solve its structure.

The function of thioctic acid in nutrition is

(*continued on page 40*)

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(*continued from page 38*)

not fully understood but it is known to form part of an enzyme system needed for the oxidation of carbohydrates in tissues of higher animals. It is related to the B complex vitamins and is found in liver.

According to the article in the journal over 100 tons of liver were concentrated to obtain only a few milligrams of this growth factor for chemical studies.

A REMARKABLE photographic atlas of human anatomy that may revolutionize medical education is now in use at Stanford University, San Francisco, Calif.

About sixty-five first year medical students are using the first section of the atlas in their studies of neurology. This section is comprised of 238 three-dimensional color transparencies showing progressive dissections of the central nervous system.

The four-volume Section 1 of the atlas is now available to the medical profession. It has just been published as the first of seven sections that will complete "A Stereoscopic Atlas of Human Anatomy."

Dr. David L. Bassett, Associate Professor of Anatomy at Stanford, is the author. The stereoscopic color photographs are by William B. Gruber, chief research engineer for Sawyers, Inc., the publisher.

MILK-BORNE and water-borne disease outbreaks in the United States reached a record low in 1950, the Public Health Service of the Federal Security Agency disclosed today. The statistics were contained in the annual summary of disease outbreaks.

There were only sixty-two cases of milk-borne disease, the smallest number recorded since milk-borne disease reporting began in 1923. For the first time in the 1923–1950 period no outbreaks of milk-borne typhoid fever were reported. The Public Health Service defines outbreaks of milk-borne, water-borne and food-borne diseases as two or more cases traceable to a common source.

The summary also disclosed that the number of water-borne disease outbreaks in 1950 was the lowest since 1938, when reporting of such diseases began. There were fifteen outbreaks involving 1,299 cases but for the first time since 1938 no deaths from this source were reported.

In contrast with the decline in milk-borne and water-borne diseases, outbreaks of food-borne diseases in 1950 were the second highest for the previous twelve years. The peak occurred in 1949, with 367 outbreaks involving 9,043 cases. In 1950 there were 347 outbreaks, 10,174 cases and five deaths. The five deaths were the lowest for the 1938–1950 period.

LIFE insurance companies of the United States and Canada will give more than $780,000 this year for research in heart disease, it was announced by M. Albert Linton, Chairman of the Board of the Life Insurance Medical Research Fund. The grants being made to medical schools and to individual scientists for heart disease research this year bring to $4,700,000 the total amount of money given by the life insurance business since the Life Insurance Medical Research Fund was organized late in 1945. The Fund is supported by the annual contributions of 141 U.S. and Canadian companies.

GREAT BRITAIN'S national health system is costing 50 to 60 per cent more than had been expected and is suffering from serious defects which "appear to be inherent in any system of socialized medicine," Dr. Ralph Arthur Reynolds says in the May issue of *U.S.A., The Magazine of American Affairs.*

Dr. Reynolds recently returned from his second trip in two years made for the purpose of studying England's health system. The San Francisco physician also has made authoritative studies of the socialized health plans in other European countries.

He reports that in England doctors are so rushed that they can give their patients little more than superficial attention and that many of the other shortcomings of the system noted on his earlier visit remain uncorrected.

Dr. Reynolds says that although some remedial measures have been instituted, "serious defects in the operation of the system remain with little hope of solution," and goes on:

"They appear to be inherent in any system of socialized medicine. Reviewing them briefly, we should note especially: (1) the staggering and mounting cost to the government; (2) the cumulative growth of bureaucracy with its impersonality, its aloofness and its increasing complexities; (3) the low status, financially and pro-

(*continued on page 42*)

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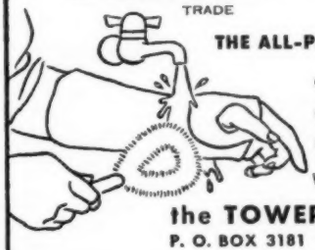

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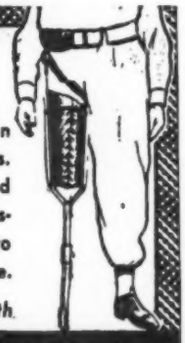

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Outside the Ivory Tower

(*continued from page 40*)

fessionally, of the overworked, routine-laden general practitioner resulting in mediocre service to his patients; (4) the temptation to malinger; and (5) the ever increasing demands for services and hospitalization—over and above the limits of necessity—due to the philosophy of 'entitlement.' "

MORE than 115,000 opportunities for professional work with handicapped children and adults await young people seeking careers, according to Lawrence J. Linck, Executive Director of the National Society for Crippled Children and Adults, in his announcement of the publication "Careers in Service to the Handicapped."

This manual was prepared by the Easter Seal Society for guidance counselors to help young people secure occupational information about positions in the fields of rehabilitation of the handicapped. Information from which the manual was prepared was supplied by the American Physical Therapy Association, the American Occupational Therapy Association, the American Speech and Hearing Association and the International Council for Exceptional Children. It is jointly published by the National Society for Crippled Children and Adults and the National Foundation for Infantile Paralysis, with the cooperation of the Office of Vocational Rehabilitation of the Federal Security Agency.

In announcing this publication Mr. Linck pointed out the tremendous shortages of personnel in auxiliary medical fields. He indicated that young people choosing rehabilitation as a career would find available choice jobs in every section of the country. Current vacancies exist, he pointed out, for an additional 4,000 occupational therapists and more than 16,000 physical therapists, and he indicated that 12,000 to 15,000 speech therapists are needed.

The National Society for Crippled Children and Adults will distribute, free of charge, more than 23,000 copies of "Careers in Service to the Handicapped" to public and parochial school systems throughout the country. In addition, copies will be given to every college and university throughout the United States. After the initial distribution, individual copies will be available at 50 cents each.

THE sixth Public Health Service nurse officer to be currently assigned to Alaska, Mrs. Vera Adams of Washington, D. C., left recently for Juneau. Mrs. Adams, who was recently commissioned as an officer of the Public Health Service, will be assigned to the staff of the Alaska Health Department's Health Center there.

Dr. Scheele, Surgeon General of the Public Health Service, Federal Security Agency, in making the announcement, pointed to the needs and opportunities for nurses in Alaska.

"Public health nurses and midwives are needed now in Alaska," Dr. Scheele said, "and the opportunity for service for both groups is virtually unlimited. Because the Alaska nurse may be the only professional public health worker in the area she serves, she has special opportunities for leadership and initiative, as well as for active participation in community health projects."

APPOINTMENT of Dr. Edward J. Stainbrook as Professor of Psychiatry at the State University of New York, College of Medicine at Syracuse, was announced recently by Dr. William R. Willard, Dean of the College.

THE National Science Foundation has announced approval of forty-one research grants, totaling $406,660, in the biologic and physical sciences.

This is the second group of research awards to be announced this year under the Foundation's program for the support of basic research, bringing the total number of announced Foundation research grants to sixty-nine. Additional proposals are being evaluated by the staff of the Foundation with the help of advisory panels of outstanding American scientists.

A TEST tube reaction for determining the presence of poliomyelitis virus in human beings was reported by three Yale scientists.

The test, which is made with tissue from monkey glands, also provides a valuable method for finding out who is immune to poliomyelitis.

The new technic was developed by Nada Ledinko, Joseph L. Melnick and John T. Riordan of the Yale School of Medicine. Their research, supported by the National Foundation for Infantile Paralysis, was reported at the

(*continued on page 44*)

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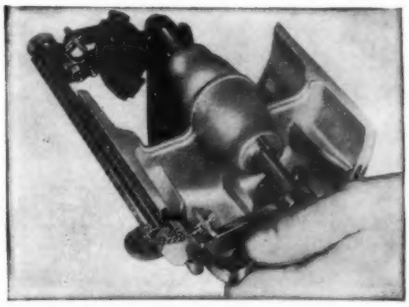

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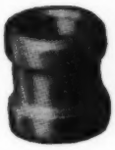

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(*continued from page 42*)

meeting of the American Association of Immunologists.

The Yale test is based on the discovery that testicular tissue from monkeys can be grown in test tubes and that cells of the growing tissue will show a change after being treated with poliomyelitis virus from humans. This change can be easily detected under a microscope.

WE have space to list only a few worth while newly published books. Provided the reader is interested in the subject covered in a work, we sincerely recommend it.

Bone Tumors by Louis Lichtenstein, M.D. contains 315 pages, 155 illustrations, references and index. C. V. Mosby Co. $10.50.

Functional Endocrinology from Birth through Adolescence by Nathan B. Talbot, M.D., Edna H. Sobel, M.D., Janet W. McArthur, M.D. and John D. Crawford. This is a 638-page, profusely illustrated book, with a thirty-seven-page index. Published for the Commonwealth Fund, Harvard University Press. $10.00.

Diagnostic and Experimental Methods in Tuberculosis by Henry Stuart Willis, M.D. and Martin Marc Cummings, M.D. is a 2nd edition. There are 373 pages with illustrations and an index. Charles C Thomas, Publisher. $10.00.

Surgical Gynecology, a Handbook of Operative Surgery Including Important Obstetric Operations, by J. P. Greenhill, M.D., contains 350 pages with 101 plates, each plate with three to five illustrations and an index. The Year Book Publishers, Inc. $8.50.

Surgical Technique by Stephen Power, M.S., F.R.C.S. There are 380 pages in this work, with illustrations and index. J. B. Lippincott Co. $6.50.

Any Questions? A Selection of Questions and Answers Published in The British Medical Journal. This first series contains 240 pages and an index. Grune & Stratton, Inc.,

You and Your Aging Parents by Edith M. Stern with Mabel Ross. M.D., United States Public Health Service, Director, Prince George County Mental Health Clinic, 212 pages. Published by A. A. Wyn, Inc., $2.75.

The Musculoskeletal System: A Symposium Presented at the Twenty-Third Graduate Fortnight at The New York Academy of Medicine, October, 1950. Edited by Mahlon Ashford, M.D., this work contains 368 pages and references. The Macmillan Company, 1952. $6.50.

The Clinical Use of Fluid and Electrolyte by John H. Bland, M.D. is illustrated and has references at chapter endings. There are 259 large pages. W. B. Saunders Co. $6.50.

The Metabolic Response to Surgery by Francis D. Moore, M.D. and Margaret R. Ball, A.B., with metabolic diagrams by Mildred B. Codding, A.B., M.A., contains 167 large pages, fifty-six diagrams and bibliography. Charles C Thomas. $7.50.

A LARGE (1,110 pages), well written and profusely illustrated (463 figures) new work on orthopedics has been published by W. B. Saunders Company—"A Textbook of Orthopedics, With a Section on Neurology in Orthopedics," by M. Beckett Howorth, M.D., in association with Fritz J. Cramer, M.D., A. Wilbur Duryee, M.D., Donovan J. McCune, M.D., J. William Littler, M.D., and Walter A. Thompson.

We learn from the Preface that "This book is the outgrowth of more than twenty years' experience in the practice and teaching of orthopedic surgery at the New York Orthopedic Hospital, the Columbia-Presbyterian Medical Center, Teachers' College, and the Roosevelt Hospital. . . . The purpose . . . is to provide the basic facts of the etiology, pathology, diagnosis and treatment of abnormalities and diseases of the musculo-skeletal system for the physician interested in these problems." In every sense the author and the co-authors have attained this goal. It is a work that the reader quickly senses is up-to-date, authoritative and well written. At chapter endings are ample references. All in all, it is a work that should be in the library of surgeons doing this type of work. $16.00.

Also published by W. B. Saunders Company, Callander's Surgical Anatomy by Barry J. Anson, M.A., Ph.D. (Med. Sc.) and Walter G. Maddock, M.S., M.D., F.A.C.S. It is a third edition. This complete book of 1,074 pages has earned a high and envious spot among published texts. No textbook of this size reaches a third edition unless it has a scientific and readable IT, which this volume has in a great degree. Suffice to say in passing, we believe most surgeons should possess this work and then give it lengthy study. For, between the covers, are the fundamentals of all good surgery. It has 929 illustrations and an index. Worth every penny of its cost, $14.

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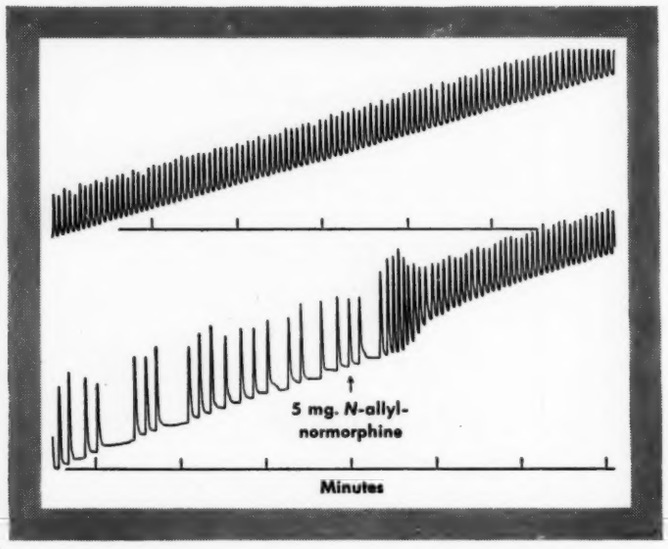

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[1]Eckenhoff, J. E., Elder, J. D., and King, B. D., *Am. J. Med. Scs.* 223:191, February 1952. [2]Eckenhoff, J. E., Hoffman, G. L., and Dripps, R. D., Annual Meeting of the American Society of Anesthesiologists, Washington, D. C., Nov. 8, 1951.

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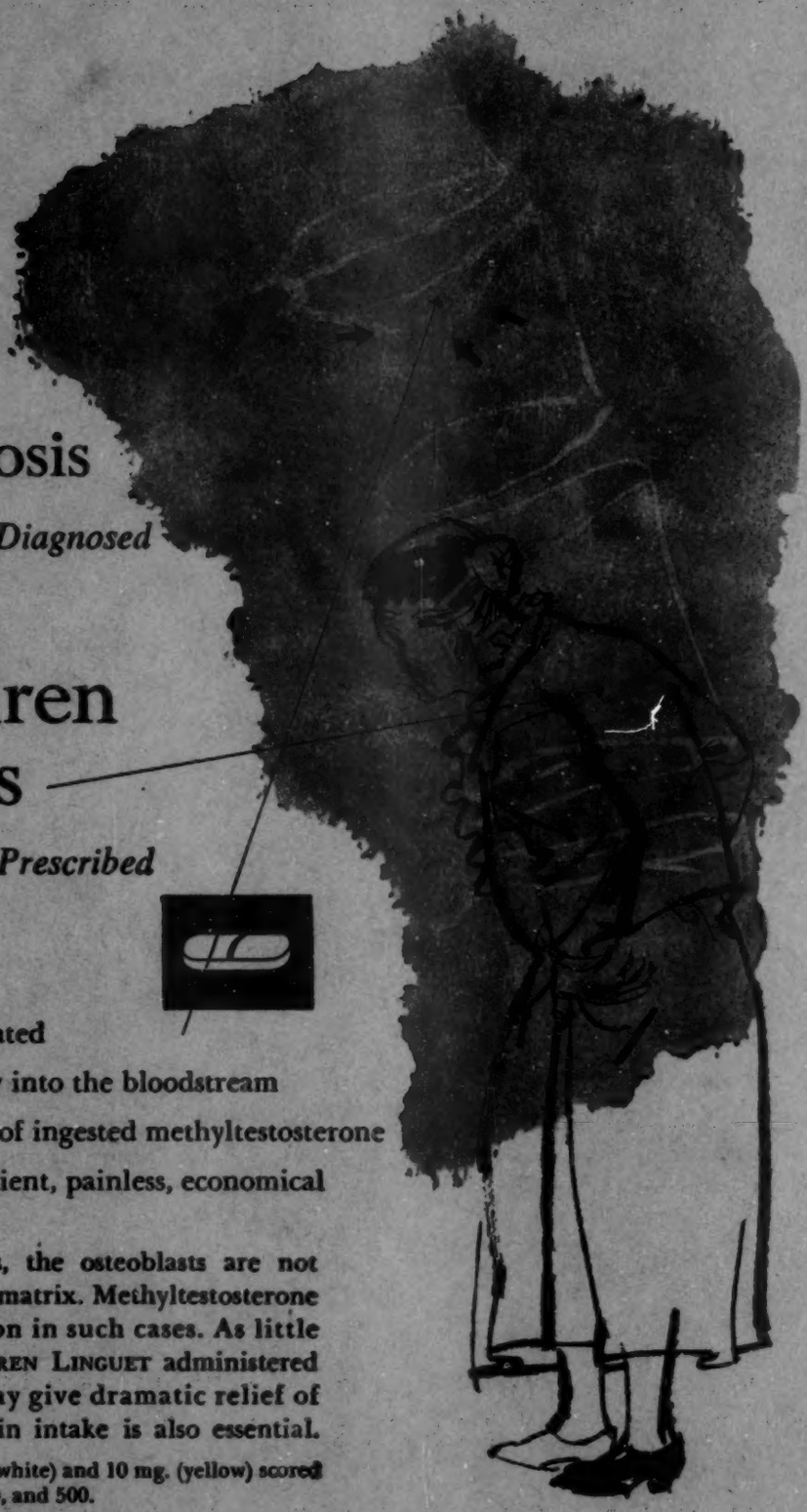

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